Introduction to Pond Management

Structure

1.1 Introduction
1.2 Cultural practices bases on different aspects
1.3 Maintenance and management of fish farm

Learning Objectives

After completion of this unit the student will able to

- Understand the cultural practices based on different aspects
- Different steps involved in the maintenance and management of fish farm.

1.1 Introduction

Ponds are very small and shallow of quiet standing water with slight wave action and may be naturally created or man made. Naturally created ponds show the same geological history as lakes. However, unless polluted their small volume and shallowness results in very rapid progress to the point where autochthonous production dominates filling up the basin.

Man-Made or artificial ponds are created to serve diverse purpose, Vix, Fish Farming, Duck Rearing, Ornamental, Cultivation of Nelumbo or any aquatic weeds. The ponds used exclusively for fish culture purposes are designed and managed scientifically these are better called as fish ponds.
All over the world, various techniques of aquatic culture have been developed from time to time, to have substantiable yield of fin fish and non-fish organism. The culture practices may be basis of habitat, economic or commercial consideration, one or multiple organism, operative design of culturing sites etc.

Therefore the culture practices can be grouped under the following categories.

### 1.2 Cultural practices Bases on different aspects

#### 1.2.1 Culture based on the kind of water (Habitat of the organism)

Fresh water, Brackish water and marine farming (mericulture) use of sewage, water has also been found profitable for culture practices.

#### 1.2.2 Culture Bases on the Economic or commercial considerations

(a) **Extensive culture**: It is least managed culture practice where there is a modest yield, raised on natural food.

(b) **Intensive culture**: In this case, maximum production is aimed with minimum quantity of water. The investment is quite high to have all the modern technological facilities, artificial feeds, fertilizers etc.

(c) **Semi-Intensive culture**: This practice stands between the about referred ones.

#### 1.2.3 Culture based on the extent or limits or development stages (s) of fish

(a) **Complete farming**: In this kind of practice, the organism is cultured right from production of eggs, up to full sized organism. This may be included the intensive type of cultural practices.

(b) **Restricted Farming**: This kind of culture of aimed at to produce the seed fry and fingerlings (i.e. immature stages) only in specially designed sites or containers and artificial or induced breeding techniques are often used to achieve the goal.

#### 1.2.4 Culture based on the types of designs of the culturing sites

Depending on the water body used or specially sites the cultures may be classified into the following categories are

(a) **Pond Culture**: It is the commonest method of culture in natural and artificially or scenically designed ponds are very small and shallow bodies of quiet standing waters with only slight wind action. Ponds are generally classified as Village ponds, Homestead ponds, Irrigation ponds, Spill ponds, Moats, Open Mine Pits, Quarries, Rock Pools etc.
The ponds may be drainable or non-drainable depending upon whether they can be completely dewatered by gravity or not.

(b) Culture in Man-Made Reservoirs: The fresh water bodies created by damming of rivers are used for stocking purposes. A dense stock of commercially important species is maintained in the reservoirs to procure a maximum sustained yield.

(c) Culture in Paddy (Pokkali) or Rice Field: Paddy fields which returns for 3-8 months in a year are used paddy cum fish culture, but mostly in those areas where paddy is cultivated on traditional lines, seasonal utilization of paddy fields or culture of brackish water prawns and fish is quite common in West Bengal and Kerala.

(d) Culture in ‘Bhereis’ or Bhasabadha: This type of fish culture or cultivation is practised in brackish water impoundments where the tidal water is admitted through the sluices in suitably embanked enclosures. These are called ‘Bhasabadha’ fisheries or Bheries in Bengal. Generally, fish culture practices in ‘Bheries’ commence from January-February when ponds are stocked with fry. Large scale fishing is done during September-November. As no tidal water is required in the ponds during this period, as much water as possible is let out so that the left over fishes in ‘bheri’ move in to deeper areas where they are caught by drug nets. Not much capital investment is needed for the embankments or sluice erection to improve fish yield from ‘bheries’. It is necessary to prevent predatory and uneconomic varieties if fishes from gaining entry into the ‘behri’.

(e) Culture in Salt-Pans: ‘Salt-Pans’ are saline area where sea water is pumped from the mouth of an estuary or otherwise into channels and is stored in large reservoirs ponds from where the water is diverted by means of sluice into secondary reservoirs ponds or salt ponds for evaporation and crystallization ponds of salt. Potentialities for culturing marine fishes and prawns in and around salt pans have long been explored. It has been found that the species tolerating high salinity conditions thrive well there for culture practices.

(f) Culture in Tank Farms: As against the ponds the ‘tanks’ are made of concrete, fiberglass, marine plywood, metal or other hard substances. As regards their shape, the tank farms may be circular or rectangular in design. ‘Fiberglass’ tanks are generally circular in outline and fiberglass in popular material for tank constructions as it is light strong and inert to fresh and saltwater.

(g) Sectional Metal Tanks: These tanks are readily available in markets and can easily be erected or dismantled. They are generally circular in outline and very commonly used for nursery and grow out purposes. Ready made
plastic coated metal tanks sections are bolted together and sealed with water proof cement. In order to protect the stock from predatory birds and other animals, the tanks are covered with suitable netting or metal screens,. Plastic or galvanized iron made tanks are also used.

(h) Culture in ‘Silo Tanks’: It is very similar to tank farms. The ‘SILO’ is a deep tank where the water is pumped down at the centre through a pipe. The water flows upwards in the culture tank and discharger into a trough constructed around the outer side of the tank at the top. The rate of flow is quite high and higher densities of fish can be grown in a ‘SILO’.

(i) Culture in Raceway farms: Raceway farms are designed in manner to have regular and abundant flow of good quality and well-oxygenated water. The main source of water are springs, streams deep wells or reservoirs. These are much smaller in size and occupy much less space the ponds. The raceways may be earthen or made of concrete or cement blocks. The earthen raceways can be lined with plastic material to reduce loss of water through seepage. Raceway far amy be in series design or parallel design. One segment of raceway can be about 3 meter long 2.5 - 3.0 meter wide at the bottom and 1.0 - 2.0 m.deep.

(j) Culture in Cage Farm: This culture practices is quite peculiar in that the fish to be cultured is kept in CAGES, of metal mesh, bamboo mesh or Nylon mesh. Left in the flowing water. In part few decades it has become a major source of aquaculture production. Particularly highly esteemed salmon, Trouts, Yellow tail. Sea bass, Groupers, murrels, pangasius species etc.

(k) Culture in the pen and enclosures: The pen (a small enclosure for domestic animals an enclosure used for confinement or safe keeping) are considered or transitional structures between ponds and cages. They are formed by damming a bay or an arm of sea, estuary, river lake or reservoirs.

The pen or enclosures are those where the barriers can be constructed across the narrow section or channels, in orders to reduce the costs and increase the ease of operation.

1.2.5 Culture Based on the Number Sex and Specially Adaptive Fishes

(a) Monoculture: This type of culture is aimed at to culture only one type of fish species in a well designed pond, tank cage etc.

(b) Poly culture: When two or more species are cultivated together it is referred to as poly culture or composite culture. The species of different feeding habits are selected and stocked together.

E.g: Chinese carp, Grass Carp, Indian Major Carps etc.
(c) Mono Sex Culture: In this case only one member of the sex, either male or female is cultured. The obvious advantages of such a practice is that all the energy of fish is utilized in growth rather than growth as well as reproduction. Thilapia are often used for mono sex culture.

1.2.6 Integrated Fish Farming

When fish is cultured along with other animals, it is referred to as ‘integrated fish farming’.

E.g: Poultry cum fish farming, Rice cum fish farming etc.

1.2.7 Fish Culture Based on Climate Conditions

Warm water culture: These culture practices are adopted in the water bodies of the tropics.

Cold Water culture: This is culture practice adopted at high attitudes.

1.3 Maintenance and Management of Fish Farm

Maintenance and judicious management of aquafarms, is identify and aspect which keeps the business or the culture enterprise profitable and save the farmers from any unwanted or uncalled for loses. An aquaculturist should be trained enough to manage and maintain the fish farm on the following lines:

• Fertilization of ponds
• Restorations of improvement of the pond bottom of liming
• Control of aquatic vegetation
• Control of weed fishes and predators.
• Prevention of fish disease
• Monitoring physicochemical characteristics of water and soil.

1.3.1 Fertilization of the ponds

The agricultural soil are found most suitable for the construction of fish farms owing mainly to the fact that they are sufficient provided with nutrients. The natural productivity of the pound can greatly be enhanced by the use of fertilizers (both organic and inorganic).

1.3.2 Improvement of the pond bottom

To retain the pond productivity of pond it is essential that the ponds are drained dry at least one in a year. This exercise is necessary to clean the ponds and repair the bottom. By doing so following objectives can be achieved.
Fish parasites disease producing germ and various stages of life cycle of harmful insects are destroyed.

Mineralization of soils is reduced particularly when there is great accumulation of submerged vegetation.

Excessive deposition of muds makes the ponds shallower and hence the same may be removed by dredging at the bottom.

After the ponds are dried and necessary cleaning is done, the pond bottoms are subjected to ‘liming’ i.e. application of lime.

**Lime is used in following forms**

- Lines stones (caco₃)
- Quick lime (cao)
- Slaked lime or caustic lime (ca (OH₂))
- Calcium cyanamide (caN₂)

Liming of pond services some of the following very important purposes. In orders to have unhindered productivity, maintain Ph and alkalinity in desired ranges, disinfect the ponds etc.

### 1.3.3 Control of Aquatic Vegetation

For sustained primary productivity the growth for producers in the form algae and aquatic macrophytes is essential but unwanted and undesirable growth of algae or plats place them in the category of menacing weeds. Generally weeds can classified into four categories they are floating weeds.

**E.g:** Pistia, Azolla, Lemna, Eichornia etc.

**Rooted weeds with floating leaves:** E.g : Nyphaea, nelumbo, nymphoides etc.

**Rooted emergent weeds:** E.g : Polygonum, Typha cyperus etc.

**Submerged weeds:** E.g : Chara, hydrilla, Naja etc.

**Control measures:** Manual, mechanical chemical and biological control measurer have been suggested to eradicate the managing weeds the selection of the method has to be based on the type of the infection, nature of the farm and specie that is cultured.
1.3.4 Control of predatory and weed fishes

The predatory fishes not only compete with cultured carps for food and space but also directly prey upon them. Some successfully breed in confinement quite earlier to be spawning of carps. Therefore they are large enough till the carp spawn is released in ‘bundhs’ or spawning ponds, to take a heavy toll of the spawn.

The majority of common weed-fishes are also active competition with the major carps for the available food in pond. They have high fecundity and ripen in summer months and can breed even in the absence of rains. Young weed fishes directly feed on carp hatchlings and the spawn.

Control measures

1. Repeated drag netting should be done to clear predatory or weed fishes.
2. Periodic dewatering the pond will definitely help in getting predatory or weed fishes removed.
3. Using filtering device at the inlet point, the entry of unwanted fish can be reduced or greater.

1.3.5 Water Quality

Periodic monitoring physio-chemical characteristics of water very essential water management is very important aspect of pond management. Exchange of water is best remedy prevention of fish disease. If the organic load is increased in the pond immediately aeration will be provided trait netting is very essential to check the growth and hygienic conditions of the fish.

Short Answer Type Question

1. Mention two different types of ponds.
2. What is Pokkali culture?
3. Define intensive culture.
4. Differentiate between complete farming and restricted farming.
5. What is Bhasabadha culture?
6. Define pen.
7. Define monoculture.
8. Define poly culture.
9. What is integrated fish farming? Give example.

10. What aspects should aquaculturists know to manage and maintain the fish farm?

11. What steps to be taken to improve the pond bottom?

12. What forms of lime are used in aquaculture?

13. Write main uses of liming in aquaculture.

14. Write any two control measures of predatory fish.

**Long Answer Type Question**

1. Write essay on different types of culture systems.

2. Explain the maintenance and management of fish forms.

**O.J.T**

Students visit to different types of culture ponds are observe different cultural practices.
UNIT 2

Layout of Fish Farm

Structure

2.1 Introduction

2.2 Component pond of fish farm

2.3 Site selection criteria for fish farm

2.4 Design and construction of fish farm

Learning Objectives

After completion of the unit the student will able to

• Understand the different types of ponds of fish farm

• Know the sire selection criteria for constructing fish farm

• Study the design and construction of fish farm

• Draw the diagram the layout plan of fish farm

• Draw the diagrams of dike cross section and a monk.

2.1 Introduction

Fish farm is the site where different types of ponds are constructed for rearing various stages of the selected species on scientific lines. Pond is nothing but a very small very shallow body of quiet standing water in which extensive occupancy of higher aquatic plants is a common characteristics. No extract limits of area ad depth have been laid down for a pond. A depth of about 2m is
Aquaculture activities starts with the construction of ponds till the harvest of table-sized fish. Important aspects of the planning of fish farms, is the selection of the site for the fish ponds. Sites should be selected taking into the consideration the agroclimatic conditions access to markets, suitable communications of skilled and unskilled labour public utilities security etc.

### 2.2 Component (ponds) of a fish farm

An ideal fish farm should contains at least 4 different types of ponds, each for a specific purpose. Sometimes the number of ponds may be increased to 6.

1. **Breeding (Spawning pond)**: Fore breeding of cultivable fishes.
2. **Hatching ponds (pits)**: For putting the spawn for hatching into fry.
3. **Nursery ponds**: For keeping fry to develop to fingerling stages.
4. **Rearing ponds**: For transferring fingerling to develop up to adult hood.
5. **Stocking pond**: For keeping adult sized (table sized) fishes.
6. **Marketing ponds**: For keeping marketable size fishes to be marketed.

**Important activities at a fish farm**: Right from the establishment, important activities at a fish farm may be summarized as under.

**Choice of Site**: Soil characteristics water resource.

<table>
<thead>
<tr>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Layout plans: Design of ponds: Drains.</td>
</tr>
<tr>
<td>Laboratory: Store house, watchman huts.</td>
</tr>
<tr>
<td>Residential quarters: Necessary implements</td>
</tr>
<tr>
<td>Chemicals: Fertilizers; Feeds etc.</td>
</tr>
</tbody>
</table>

A fish farm is established

Procurement of stocking material from (seed: Egg, spawn, fry or fingerlings).

Natural resources (like rivers, lakes etc.)

Induced breeding by hypophysation
or

From fish seed traders (Hatcheries)

**Nursery ponds** : (Spawn introduced)

**Rearing ponds** : Culturing fry to fingerling stage

**Stocking ponds** : Growth of fingerlings to table sized fish

**Harvesting** : Table sized fish netted out of stocking or marketing ponds

Transport and Marketing.

### 2.3 Site selection criteria for fish farm

1. Availability of land in a continuous suitable shaped plot of optimum six with all facilities.
2. The site should have assured water supply of adequate quantity either surface or ground water.
3. Soil and water of the site must be suitable for fish culture.
4. The site should be free from floods
5. The site should have good transport facilities and approach roads
6. The site should have electrical and telephone connections
7. The fish seed should be available easily and in plenty in that area
8. The site should be away from populated areas
9. The site should be connected to a drainage system
10. The site should be away from polluted areas.
12. The fisherman or labour should be available near the site.

The following are the major that work together to make a good site for a fish farm.

#### 2.3.1 Topography

The term topography means the surface features of the area, and it important both from the point of view of construction and for future maintenance. The ideal topography of a fish farm site a gently sloping terrain of wide valley or a bowl. Shaped area with high lands on the three sides and a narrow outlet with fourth. Such a place can be chosen for constructing the farm, provided the desirable type of soil and suitable water supply is available.
2.3.2 Soil type

The soil must be impervious so as not allow any seepage. Rocky and sandy soil as well as limestone areas are to be avoided. Generally heavy clay and silt clay are suitable and fish ponds constructed in such areas store water for long periods as the loss of water in only to evaporation. Porous soil is considered unsuitable for constructing ponds. A correct identification of soil can be done by a soil analysis, and a good soil would result in a fertile pond.

2.3.3 Water supply

The availability of adequate supply of water is an important requisite for site selection. The dependable sources of water supply are.

(a) Lake or Reservoirs
(b) Springs
(c) Rivers
(d) Streams
(e) Canals
(f) Surface run off
(g) Wells
(h) Tube wells

Big tanks reservoirs and lakes are perhaps the best source of water. Dams provide the cheapest and canals are also satisfactory source of water, provided the flow is enough to fill the ponds. The source of water should be free from all pollution.

2.4 Design and Construction of Fish Farms

2.4.1 Design (Plan)

There are three types of Design

1. Layout planning
2. Man-power planning
3. Material planning

2.4.2 (1) Layout planning

Layout planning is an important factor. It helps as how to utilize the available area to its fullest extent for the production purpose at the same time
economizing the construction as well as management aspects. Layout planning consists of allotting positions to different types of ponds, water and drainage channels. Buildings etc. Depending the topography of the area layout planning requires a boundary map, contour map and soil profile charts.

Design Consideration

(a) **For Dyke** : The embankment should be designed very carefully. Before designing a thorough surveying regarding the type of soil and its properties such as a permeability and bearing capacity should be made.

(b) **Height and Breadth** : Height and breadth of dyke should be determined in accordance to the depth of water and nature of water source. Usually the heights of dyke is kept at least 50 cms above the expected water level in the ponds. Top width and bottom width will be determined depending upon the slope.

(c) **Free board** : Extra space provided between maximum water level in the pond and crest level of embankment is called as free board. The free board is generally kept 0.5 mm for heights of embankments 3.0 m and under.

(d) **Top Width** : Top width or dyke can be determine by using the empirical formula.

\[
W = \frac{H}{5} + 3
\]

Side Slopes

The table given below shows the safe slopes required to provided for different types of soils and height of dyke.

<table>
<thead>
<tr>
<th>Nature of soil</th>
<th>Height up 2.5 m H:V</th>
<th>Height Up to 2.5 m 4.5 m H:V</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Ordinary larch soft clay, dry sand</td>
<td>1.5 : 1</td>
<td>2 : 1</td>
</tr>
<tr>
<td>2. Loose earth loose sandy loam</td>
<td>2 : 1</td>
<td>3 : 1</td>
</tr>
<tr>
<td>3. Wet sand</td>
<td>2 : 5 : 1</td>
<td>4 : 1</td>
</tr>
</tbody>
</table>

2. **Design of ponds**

The nursery pond are generally shallow and small in size (0.5 ha. To 0.10 ha) and stocking ponds are 1 to 2 ha., and rectangular in shape with 0.7 to 1.2
m depth. A provided between pond bottom and embankment top should be fail. Born also makes netting operation easy.

A ration of 1 : 2.5 should be kept in breadth and length of pond. A slope towards outlet and inlet should be given to provide better drainage and easy harvesting.

The pond embankments should have 2 to 3 width with side slopes 1 : 2 or more at outer side that of inner side should be slightly more than that of outer side.

3. Design of Water Channel

There are two types of water channels

1. Main water channel
2. Subsidiary water channel

Through the main water channel the farm receives the water, which in turn distributed to the different ponds through the subsidiary channels.

The depth of main channel should be more for easy draining out of water from ponds. The position of main water channel should be position, above the main water sources.

2.4.3 (a) Man Power

This provides an answer to the question of quantum of work and time number of labour required the place and type of work and time chosen for the construction on the best of each work excavation number of man days etc.

Earth work involved

The earth work involved in a excavation for ponds can estimated by any of the methods given below :

1. By thumb rule

   Volume of earth = Average area of cross section X depth

2. By prismoidal rule

   As per this method the volume of this earth to be removed can be estimated by using following formula

   \[ V = \frac{L}{3} (A_0 + A_1 + A_2) \]

   Where \( L \) = Distance between two cross section
Ao = Area of C/S at top
A1 = Area of C/S at middle
A2 = Area of C/S at bottom

3. By Trapezoidal rule

\[ V = \frac{L}{3} (A_0 + 2A_1 + A_2) \]

Where
- \( V \) = Volume of earth to be excavated
- \( L \) = Distance between two cross sections
- \( A_0 = \) Area of C/S at top
- \( A_1 = \) Area of C/S at middle
- \( A_2 = \) Area of C/S at bottom

Consolidation and compaction

After digging the man power should be utilized for consolidation and compaction of pond bottom and embankment sides. Depending upon the mode of work, a margin of 5 to 10% of manpower can be provided in the estimate. One labour can do not the operation of watering ramming, in layers (1.5 cm height) in one day.

Other work as buildings and lining of ponds.

The manpower requirement for constructing the office buildings staff quarters for lining of ponds etc., should also be calculated or even a contract can also be given as per scheduled rates prevailing in the area.

2.4.4 Material Planning

It involves the procurement of raw material, equipment for various operations, arrangement for storage and labour transportation etc., At time sudden shortage of any material due to non-availability may hamper the construction works, therapy keeping the labour idle till the arrival of material resulting in heavy financial loss.

Construction of temporary shed in necessary to keep all materials and equipment in safer position with proper watch and ward. To tides attached to it.

2.4.5 Constructions

The following sequence of operations are to be followed
2.4.6 (b) Land Clearing

Deep rooted trees, bushed shrubs cause leakage and lead to crack in the embankment, stones, rocks may pose problems at the time of excavation. Hence eradication of vegetation and removal of stones, rocks.

2.4.7 Construction of embankment

The side should be cleared of all types roots, grass etc. The surface should be roughed by ploughing all over. The centre line should be drawn.

The foundation of embankment should be stable to withstand enormous weight of dyke. The dyke should be built in layers of 256 to 35 cms in thickness over the across the whole section. Water should be sprinkled over the previous layers. Each layer should be rammed well until clods are flattened to have a good adhesion between successive layers.

The dyke should be strengthened by planting trees to protect from wind. Grass turf should be grown to provide vegetation.

2.4.8 Water channels

Earthen channels can be parabolic, trapezoidal or triangular types as per their construction.

Here also free board is to be provided to avoid overflow.

For fresh water fish farms trapezoidal shaped channels are well suited, with lined bed and sides. The main channel must be constructed with great care. The depth of water channel is kept more than the elevation of ponds. Water channels may be constructed in brick masonry or stone masonry after may be constriction lining is to be done properly.

2.4.9 Construction ponds

The depth of pond should be such that, it should retain adequate water even in lean months. The pond should have its inner side embankment wide enough are side slopes of the pond embankment on its inner side. The pond at its outer and slightly more on its inner. The pond should have a berm in between pond into the pond. This will also ease the netting operations.

The size of nursery point is generally small (0.5 to 0.10 ha) and that of stocking is rectangular in shape and of 1 ha to 2 ha. Lining of the ponds may be done to reduce the seepage.

2.4.10 Linings

It has got many advantages such as reduction of seepage losses, increased
Water holding capacity etc. It also resists the erosion of dykes and channel banks. Lining also facilitates maximum harvesting especially in the case of prawns.

**Lining can be done in following ways**

1. Concrete lining  
2. Soil cement lining  
3. Polyethylene film lining  
4. Compacted earth lining  
5. Brick or cement tile lining  
6. Plaster lining etc.

The plan should induce provision for handling normal flow of water as well as for complete drainage. The drainage pipe should be large enough for quick drainage. The inlet pipe should be 6-8 above the water level and provided with some kind of screen to prevent entrance of wild fish and escape of fish from the pond. Alternatively “SLUICE” can also be used at the desired point of the pond.

The water supply to the pond is to be monitored through the inlets and outlets and for that different types of water control structure are in use. Monk is used as outlet structure.

**2.4.11 Monk construction**

It is most efficient water control structure used for both inlets and outlets. The MONK is a sort of “U”-Shaped vertical tower comprising three walls, two lateral walls and a back wall. The side wall of the monk have 3 pairs of grooves for inserting screens and stop logs or flash boards. The groove facing the pond is inserted with a screen often made of metal sheet and perforated as to prevent debris from entering the pond and fish from escaping. Stop logs or flash boards are inserted in rest of two grooves behind the screen. To prevent leakage of water the space between the boards can be filled tightly with wet clay or compost.

At the base of the back wall of the monk is fitted a horizontal pipe which passes through the base of the dike for drain water. The diameter of the pipe depends upon the size of the pond.

**Short Answer Type Question**

1. Define fish farm.

2. Name of the component ponds of fish farm.
3. Define “topography”.
4. What type of soils are suitable for constructing pond?
5. What are the dependable source of water supply for fish farm.
6. What is free boards?
7. Write the thumb rule of earth work involved in an excavation for pond.
8. What the size and shape of the stocking pond.
9. What is Prismoidal rule?
10. In what ways lining of the pond can be done?
11. What are the uses of lining in the construction of pond?
12. Draw the diagram of cross section of embankment.

**Long Answer Type Question**

1. Describe the site selection criteria for fish farm.

2. Describe the design and construction of the fish farm.

**O.J.T**

Students should visit and observe the pond/fish farm at the time of construction.
3.1 Introduction

With the fish culture operations having gained its full momentum with its proven economic returns, there arose an ever increasing demand for fish seed of different sizes, spawn (5-6mm) fry, (22-25mm) fingerlings (36-55mm) the rearing of which is highly a technical work of the three the rearing of spawn to tender is a very delicate technical work as the of spawn to fry it spawn tender and succumb to abrupt changes in the physico chemical condition of water and can be easily preyed upon. Hence their rearing is to be done in specially
prepared ponds the nursery ponds. Even the small perineal of seasonal water bodies domestic pond can be used for the same purpose.

The best manageable size of nursery pond is 20 x 10x 1 tms. A perquisite of nursery pond maintenance is a study water level of one meter throughout the rearing period, and sufficient fertility of soil and water to augment the production of natural fish food organism. The basic guiding principle of nursery pond management is to provide a proper ecological condition therein for the survival and growth of the spawn in it involves prestocking, stocking and post spawn stocking management.

3.2 Nursery pond Management

It involves pre stocking, and post stocking management.

Pre-Spawn stocking nursery pond management

(a) Dewatering drying

The nursery pond management operations starts right from the summer. As the stagnant water is highly unproductive which may harbour predatory species. It is essential to dewater the ponds, which is then subsequently exposed for drying. Drying of such water bodies in summer helps mineralization and removal of excess organic material.

(b) Desalting

When silted water is used for the nursery pond the silt settles at the bottom which contain the excess organic matter. This silt which is reinforced by the organic decomposition of manures has to be removed and the resulting earth can be used for strengthening bundh. After watering the manorial value of it becomes available to the pond adding to its productivity.

Miner repair pertaining to inlet-outlet is to be attended during this time.

(c) Control of predators

In cases the ponds could not be dewatered and dried, the possible predatory and weed fauna in the water body is to be eradicated by netting or using fish toxicants. Channa species, clarias batrachus, Glossogobius gyur is form the main predatory fishes and Esomus danricus, oxygaster bacaila, puntius species form the main weed fishes in fish ponds. These species brings a mass mortality of the spawn in the nursery ponds by direct preying and utilizing the fish food organisms which other wise should have been available to the spawn. Normally they breed with the onset of monsoon their fry becomes ready for predation by the time the pond receives the spawn.
The customary method of drag netting is not absolutely foolproof may easily succumb to chemicals. Hence a toxicant which is effective at a very low dose leaving not residual effect in the water body is to be selected.

### 3.2.1 Fish Toxicant

The common fish toxicant used for killing predators falls into three categories.

**Poisons of plant origin**

**(a) Derris root powder**

The application of derris root, powder as fish toxicant is widely prevalent among fish culturists. It is a contact poisons with 5% rotenone, damages the respiratory system of the fishes and a connection of 4 ppm is effective against all forage fishes. This is not an added advantages of a toxicant on the aquatic insect fauna such as dragonfly nymphs, back swimmers. The required quantity of derris a root powder si applied 12 days prior to stocking. It is mixed thoroughly with water and sprayed over the water surface.

**(b) Mahua Oil Cake**

Mahua oil cake at 200-250 ppm is applied 15 days before stocking and pond effectively kills in predatory fishes. Mahua oils cake containing -6% saponin enters the blood stream of fishes causing hemolysis and subsequent mortality. The application of mahua oil cake has gained wide popularly due to its fertilizing effect after toxic effect.

**Chlorinated hydrocarbons**

**(a) Endrin**

Endrin in the form Tafadrin -20 is found on ideal chemical fish in toxicant however due to its hazardous residual effect, it is not advised for application in nursery ponds.

**(b) Organophosphates**

The usage of organophosphate as fish toxicant is preferred over chlorinated hydrocarbons as they degrade easily in water medium. Thiometon DDVP, Phosphamidon are some of the commonly used fish toxicants in India.

**(d) Control of Aquatic Weeds**

Perennial water bodies is used for nursery operations may contain luxurious growths of various aquatic weeds which should be removed manually considering the small size of nursery ponds.
(e) Watering

Water from any source can be used for nursery ponds. After passing it through a fine sieve to get rid of predators and insects in any stages. Generally nursery ponds are watered raising before stocking initially to 30 cm and subsequently raising it up to a 1 meter.

(f) Fertilization

The fertility of a pond depends on its soil base, which can be greatly enhanced by applying artificial fertilizers which provides the required nutrients, vitamins, leading to a sustained production of plankton biomass. Nitrogen, phosphorous potassium, calcium, play a significant role in pond fertility along with trace elements like Maganese, Boron, Iron, Copper Zinc, whose real part of yet to be established. Fertility of pond is achieved through inorganic fertilizers or organic fertilizers or a combination of both.

3.2.2 Fertilizers

(i) Inorganic fertilizers

The different inorganic fertilizers used in fish ponds are

(a) Phosphate fertilizers

Phosphorous is the single most important element controlling organic productivity in natural waters, and has been proved in different experiment. According to Saha and Chatterjee (1979) triple experiments (40% .p2) can maintain more soluble phosphorus in the water phase then single superphosphate in the soil phase.

(b) Nitrogenous Fertilizers

The role in nitrogen in fishery waters is correlated with the level of organic nitrogen. This important nitrogenous fertilizers used are sodium nitrate, Ammonium sulphate, Ammonium, Urea.

(c) Potassium fertilizers

Potassium finds its application in pond waters with nitrogen and phosphorous popularly known as NPK fertilizers in the ration 6:8:4.

(ii) Organic Manures

Organic manures are enriched with all the nutrients required for a fishery water and an addition to it slowly decompose imparting the nutrients contained in it for the biomass production in the water body. But their use has to be cautiously administered because the may act as possible carriers of diseases.
The organic manures belong to three categories depends upon the carbohydrates content as.

(a) **Organic manures containing little or no carbohydrates**

E.g : Liquid manure from stables and byres.

(b) **Organic manures containing carbohydrates and Nitrogenous matter.**

E.g : (Farmyard manure)

(c) **Organic manures containing mainly carbohydrates**

E.g : Ground nut oil cake , Mustard oil cake , Mahua oil cake.

### 3.2.3 Methods of fertilization

Nursery ponds are fertilizers in the following way

(a) **Liming**

This is the first steps in the fertilization of a nursery pond. The quantity of lime to be applied depends on the PH of the soil. After assessing the PH of the soil. The concentration 10-15 days before watering.

<table>
<thead>
<tr>
<th>PH range</th>
<th>Quantity of Lime kq/ha</th>
</tr>
</thead>
<tbody>
<tr>
<td>4 - 4.5</td>
<td>1,000</td>
</tr>
<tr>
<td>4.5 - 5.5</td>
<td>700</td>
</tr>
<tr>
<td>5.5 - 6.5</td>
<td>500</td>
</tr>
<tr>
<td>6.5 - 7.5</td>
<td>200</td>
</tr>
</tbody>
</table>

(Taken from and fishery of India - V.G. Jhingran)

(b) **Manuring**

In the customary way of manuring the pond can initial dosage of 10,000 kg/ha of Raw Cattle Dung 15 days before stocking the spawn followed by 5,000 kg/ha 7 days after stocking of pond produces of good zooplankton bloom. But the later technological advancement aimed to modify the methods of manuring yielding better plankton production and subsequent high survival. The following methods have gained wide ground and is popularly practices.

(i) **Shirquar method** : Raw Cattle Dung 5000 kg./ha ground nut oil cake 250 kg/ha single superphosphate 250kg/ha are mixed together with water to form a thick paste and subsequently spread. Uniformly on the water column three days before stocking, yields good zooplankton production on the 3rd
day. Manuring the required number go ponds after assessing the expected spawn from the number of good eggs is in advantage of this method.

(ii) Cife Method: The combination of organic and inorganic manures is given in two split doses in this method.

(a) Raw Cattle Dung 5000 kg/ha: Ground Nut oil cake 500 kg/ha single superphosphate 250 kg/ha after mixing properly with water to form a thick paste in applied uniformly in the water column 5 days before stocking.

(b) Raw Cattle Dung 2500 kg/ha: Ground nut cake 250kg/ha is applied as mentioned above two before stocking. A sustained zooplankton production is an advantage of this method.

(c) Insect Control

A high survival in nursery pond can be expected only if the insect population is completely eradicated which otherwise will prey upon with spawn in addition to being competitors for the food. Among the insect beetles back swimmers water bugs, water scorptions, dragonfly nymphs cause considerable harm to the span in nursery ponds.

(a) Repeated drag netting using a fine method (1/16) on the previous day of commissioning the one can eradicate the insect population in nursery pond in to a considerable extend.

(b) Most of aquatic insects utilize the atmospheric oxygen for respiration which if cut off from the water column will lead to its mortality by suffocation. This is achieved through. ‘Oil emulsion’ by producing and uniform oil firm over the water surface.

The customary method of using soap and cheap oil being very costly the following recent method of widely practiced and found to be very effective. In this “Hyoxide 1011” manufactured by HICO pvt. Ltd. Bombay si used as emulsifier in combination with high speed diesel oil. The application doses per hectar of water body is.

<table>
<thead>
<tr>
<th>H.S.D</th>
<th>50 Liters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hyoxide</td>
<td>50ml</td>
</tr>
<tr>
<td>Water</td>
<td>5 liters</td>
</tr>
</tbody>
</table>

The emulsion is spread over the water surface during still weather condition a day prior to spawn stocking in the pond.

The prepared nursery pond is ready to receive the spawn. However for the proper management the water is to be analyzed for different physcio chemi-
cal parameters and plankton is to be assessed qualitatively and quantitatively.

### 3.2.4 Water Quality

Wide variations in the physicochemical nature of the water from the optimum range will lead to mass mortality of the seed. When all the steps in the nursery pond management are done in scientific way the physico chemical condition of water are expected to vary within the optimum range.

Turbidity temperature depth are important physical factors controlling productivity in an pond. Some of the chemical parameters of the pond water in the following range are considered to be conductive for the nursery pond.

- **DO**: 5-710 ppm
- **PH**: 7.5 - 8.5
- **Free Co2**: Below 16 ppm
- **Alkalinity**: 100-200 ppm
- **Phosphate**: 0.2 - 0.4 ppm
- **Nitrate**: 0.06 - 0.1 ppm

**Plankton**: The water sample from the pond is analyzed for plankton for its qualitative and quantitative content. For assessment of the plankton 50 liters of water collected from different parts of the pond filtered through a plankton net made of bolten silk cloth No.21 or organdy cloth. The plankton sediment of 1.0 to 1.5 cc in 50 liters of filtered water is sufficient for nursery rearing. Cladocerans. Diameters are the choice food of Indian major carp spawn.

### 3.2.5 Stocking

Nurseries are stocked in the morning hour before the water gets heated up or in the evening hours when water gets cooled. The buckets with spawn is slowly dipped in the pond so that the spawns gets acclimatized to the pond water and voluntary comes out of the buckets.

The nursery ponds are generally stocked at the are of 5 million/hectar. However a stocking density of 5-10 million/ha is found to yield survival and growth over a period of 15 days of rearing.

(iii) Post Stocking Management

(a) Feeding

Soon after the entry into the pond the spawn starts voracious feeding on the plankton. Within a couple of days the plankton population gets depleted.
Hence a supplementary diet is resorted to as to keep up the plankton biomass. An artificial feed should have nutrients and energy level close to that of natural food. A better survival can be obtained in a nursery if both are present in the optimum level.

The artificial feeds are given from the second day in wards of commissioning the pond. An average Indian major carps spawn powdered 1.4 mg, Nursery ponds are fed with rice bran and finely powdered ground nut oil cake in 1 : 1 by weight. The following feeding schedule is more economical and gives better survival.

- First 5 Days : Equal to the initial body wt of spawn stocked.
- Second 5 Days : Double the initial body wt of the spawn stocked.
- Third 5 Days : Thrice the initial body wt of the spawn stocked.

For better utilization half of the feed is given during the morning hours and half during the evening hours in every day.

(b) Harvesting

After 15 days of rearing the fry attains a size of 20-25 mms and the stock is ready for harvesting. Using 1/16 mesh cotton drag net pond is harvested repeatedly netting the survival range would be 60-85% with an average of 75%. The harvested fry required to be transferred to larger rearing ponds.

3.3 Rearing Pond Management

Rearing of the 15 days old fry (25 to 30 mm) to the fingerlings (100-150mm) size in a large pond with in shortest period of 3 months time is called rearing pond management.

A rearing pond should have an area of 0.8 to 0.1 ha preferably rectangular in shape with water depth ranging from 1.5 to 2 mts.

The utility of the rearing pond culture is to provide more space to fry reducing stocking density and at the same time providing a larger pond than the nursery pond for their proper growth and development. On the other hand, the 15 days old fry are reared in the same small nursery pond, their growth will be retarded and hence production will be hampered.

The management of rearing pond is broadly discussed in three stages

1. Pre- Stocking management
2. Stocking management
3. Post stocking management
3.3.1 Pre-Stocking management

Eradication of Aquatic Weeds

Being somewhat deeper and longer than nursery ponds, rearing ponds are more liable to get infested with weeds. An overgrowth of weeds deprived the pond soil of nutritive elements, restrict movement of fish interferes with netting operations and harbours predatory and weed fishes and insects. Weeds occupying different habitats and insects have to be controlled in different ways.

Floating weeds like Eichornia and Pistia are best removed by manual labour. Chemicals like 2,4-D are quite effective and economical against Eichornia. When mixed with common domestic detergent 2,4-D effectively against weeds like Pistia Nympohae and Nelumbo. Taficide 80, at a dose of 2.2kg/ha is also effective against Eichornia.

Marginal weeds like typha, grasses, sedges, Ipomea, sagittaria and colocasia are effectively controlled by ploughing grazing by live stock burning during dry season or repeated cutting.

Rooted emergent weeds like Trapa, Myriophyllum etc, are successfully removed by repeated cutting leaves before fulling at weekly intervals for about six to eight weeks. Alternately spraying once or twice with 2,4-D (at 5.6 -11.2 kg/ha) kills these plants.

Rooted submerged weeds like Hydrilla Vallisneria, Potamogeton, Najas and Ceratophyllum are mostly trouble some and their remove any manual labour is tedious and costly. The submerged weeds are killed if the water is made turbid for a long time. Copper sulphate in combination with ammonium is also found to be effective. Sodium arsenide at 5-6 ppm is also found to be effective in killing submerged weeds.

Some of the better known fishes that are used for biological control of weeds are the grass carp. Ctenopharyngodonidella and Puntius Javanicus. Grass carp feeds most control infestation of Ottelia Valliharia, Utricularia, Trapa and Myriophyllum.

Anhydrous ammonia gas, obtained in gas cylinders control Hydrilla, Najas, Wolffia, Nympheans, Ottelia and Nelumbo when injected in the surface layers with an application and 112-334 kg/j or 6.9 - 19 ppm.

3.3.2 Eradication of Predatory and weed fishes

Weed fishes (e.g Puntius spp. A.mola, E. Danricus etc.) Are those which compete with the culturable species of fishes for food, space and oxygen and causing serious problem to fish culture.
Predatory fishes (e.g. Channa spp, Clarias sp, Wallago atty etc.) are those which besides causing the above mentioned problems also directly prey upon the fry and fingerlings of the culturable species.

According to Alikunhi (1957) a single fry of Wallago atty consumes as may so 1094 carp fry in 40 days.

Thus eradication of predatory and weed fishes is an essential step in rearing pond management.

These fishes may be controlled by repeated drag netting or by complete dewatering of the ponds. However when this is not possible and effective the unwanted fishes may be killed by the application of Mahua oil cake an effective fish toxicants a 2000-2500 kg/ha (at 1 meter water) to 200-250ppm/ Which kills toxicant fishes of the pond with in 4-6 hours. The effect of the toxicant lasts for about 21 days after which it acts as 5% votenon content at a dose of 4.20 mg/l is perhaps the commonest pond toxicant used.

3.3.3 Liming

The advantage of liming pond are numerous enhances pond productivity and improves its sanitation. It is both prophylactic and therapeutic specific advantages.

(a) Kill, pond bacteria fish parasites and their intermediate life history stages.

(b) Builds up alkaline reserve and effectively stops fluctuations of PH to alkaline levels.

(c) Renders acidic waters usable for aquaculture by raising their PH to alkaline levels.

(d) Neutralizes iron compounds which are undesirable to pond biota including fish.

(e) Improves pond soil quality by promoting mineralization.

(f) Precipitates excess of dissolved organic matter and thus reduces chances, of oxygen duplications.

The commonly available and used forms of lime are

- Calcium carbonate (Ground lime stone)
- Calcium Hydroxide (Slaked lime)
- Calcium oxide (Quick Lime)
Can be applied to the pond bottom 200-250 kg/ha-added to water at inlets or uniformly board cast on the water surface depending on the form of lime used.

3.3.4 Pond Fertilization

The next step in rearing pond preparation is fertilization, the objective of which is to have sustained production of adequate quantities of zooplankton which forms the natural food of carp fry.

The production of zooplankton rearing ponds are treated either with organic manures (such as cattle, pig or chicken manure droppings) alone and or with organic fertilization are used they may be applied either one following the other or as a mixture.

(a) Organic manuring: Organic manures raw cattle dung is generally used as 10,000 organic manure raw cattle before the anticipated of stocking.

(b) Inorganic Fertilization: Inorganic manures such as super phosphate can be used @ 250 kg/ha before stocking.

Eradication of Predatory aquatic insects

Among all predatory aquatic insects most harmful insects to the carp fry are Notonecta and Cyblister larva which directly feed on fry, apart from these other insects are also having harmful effects such as they compete for food and apace sary to get high production yield.

Aquatic insects can be eradication by repeated drag netting and by spraying an emulsion of high speed diesel oil 50 l/ha with hyoxide 50 cc/ha along with water 5 l/ha on water surface.

Stocking management

In rearing ponds the fry of IMC and Chinese are stocked in various combination at densities ranging from 2-3 lakhs/ha in the following rations.

<table>
<thead>
<tr>
<th>Species</th>
<th>Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catla + Rohu + Mriga</td>
<td>2 : 4 : 4</td>
</tr>
<tr>
<td>Silver carp + Grass carp</td>
<td>1 : 1</td>
</tr>
<tr>
<td>Catla + Rohu + Grass carp + Mrigal</td>
<td>4 : 3 : 1 : 5 : 1 : 5</td>
</tr>
<tr>
<td>Silver carp + Grass carp</td>
<td>3 : 1 : 5 : 2 : 5 : 3</td>
</tr>
<tr>
<td>Common carp + Rohu</td>
<td></td>
</tr>
</tbody>
</table>
3.3.5 Post stocking management

Supplementary

Supplementary feeding consisting of a mixture of ground nut / mustard oil cake and rice brain at 1:1 ratio by weight in powders form broadcasted everyday in the pond during morning hours from the first day of stocking. The feeding schedule as shown below may be followed for 3 months rearing period.

<table>
<thead>
<tr>
<th>Period</th>
<th>Quantity of Feed day/Lakh of Fry</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Month</td>
<td>6 kgs</td>
</tr>
<tr>
<td>Second Month</td>
<td>10 kg</td>
</tr>
<tr>
<td>Third Month</td>
<td>15 kg</td>
</tr>
</tbody>
</table>

It is always desirable to stock fry, harvested from the same pond and of the same age and size groups. The seed should always be released in early morning when the temperature is somewhat cooler. Before releasing into the pond, the seed should be taken in a piece of cloth and dipped once each in potassium permanganate and saline solution for a few seconds and then released gently into the pond. This helps to prevent the young fishes from any sort of infection. The artificial feeds may be suspended when the pond water turns thick given or bloom develops.

Manuring

During the culture period both organic and inorganic manures should be applied at 15 days interval in order to enhance zooplankton and pytoplankton respectively.

1. **Organic manure**: Single supper phosphate
   
   40kg/ha/month.

2. **Inorganic manure**: Raw Cattle Dung should be applied 1000 kg/ha Month.

Liming

During the culture period liming should be done 25kg/ha/month liming should be followed on bright days and should be avoided on cloudy or rainy days.

Netting Operations and Harvesting of fingerlings

Netting should be done regularly at least once a month, the more the netting in a pond the better will be the yield of good sized fingerlings in pond.
After 3 months the fingerlings can be harvested by which time they attain an average weight of 150-20gms. Supplementary feeding should be stopped a day before, harvesting. Harvesting should be done during cool morning hours.

### 3.4 Stocking Pond Management

**Introduction:** Raising of fingerlings to table sized fish in large ponds (0.25-10.0 ha area and 0.8-3.0 depth) is referred to as the stocking pond management. Most of the following activities in the stocking pond management are similar to those of nursery and rearing ponds. To get maximum production of fish utmost care should be taken through the most economic management measures. The principles in the rational management of stocking ponds are increasing the carrying capacity or the maximum standing crop. A pond can support a fish biomass up to only certain level or limit. This limit is called the carrying capacity or the maximum standing crop.

Carrying capacity of ponds are increasing by fertilization and supplementary increasing by fertilization and supplementary feeding, optimum utilization of ecological riches in the pond by good management of water quality, the culture of first growing species and fish health monitoring. The management of stocking pond is broadly discussed in three stage as in rearing ponds.

1. Pre-stocking management
2. Stocking management
3. Post stocking management

#### 1. Pre-stocking management

In this management the steps have taken before stocking the fish seed into the culture pond. Such management is called pre-stocking management pre-stocking management which involved following steps.

1. **Dewatering:** (Removal of water)
2. **Desilting:** (Removal of sand)
3. **Ploughing:** (To improve soil condition)
4. **Manuring:** Fertilization of pond by organic and inorganic manures.
5. **Liming:** Liming increases the productivity of a pond and improves sanitation.
6. **Watering:** After the lime has been applied to the pond bottom for at least two weeks, the water should be in slowly. The water should free from all pollutants. Physical and chemical parameters of pond water should maintained.
2. Stocking management

Stocking is used to describe the act of placing the fish seed into the pond. The stocking density is used to describe the total number of fishes, which can be stocked in a pond. The stocking ponds are generally stocked with fingerlings that are about 75-100mm in size. The stocking rate depends on the volume of the water and size of the pond. The ratio of fish to the volume of water should not be less than 1 fish to 2m³ of water where there is no forced acceleration.

Generally pond should be stocked with the surface feeders (like catla, silver carp). This should not be more than 30-35%. Rohu and grass carps are column feeders and it should not be stocked more than 15-20%. Bottom feeders such as marginal and common carp together can be stocked to extent of 45%.

If fish seed in stocked in a pond. There is enough oxygen, no temperature difference between the stocking water and pond water. When the fingerlings are transported from a far away place, in order not to stress the fish, the bags with fingerlings are placed in the pond unopened until the water temperature inside the bags is about the same as the. Temperature in the pond when it is same the fingerlings are allowed to swim out of the bag in to the pond water by themselves. This process is called acclimatization. The fingerlings should not be poured into the pond water, as they die because of the stock of hitting the new climatic water.

3. Post stocking management

Them management followed after stocking the fingerlings of fish seed is called post-stocking management.

Feeding

It is discussed in rearing pond management.

Manuring

During the culture period both organic and inorganic manures should be applied at 15 days interval in order to embrace growth of planktons.

(a) Organic manure: Raw the dung should be applied @ 1000 kg/ha month.

Liming

During the culture period liming should be done @ 25kg/ha/month.
Growth and health care

The health of the fish needs to be checked periodically. A check on the water quality and hygienic condition of the pond is mandatory for healthy growth of fish. The stress factors and rough handling causes diseases periodically. Trial netting should be done to check the growth and health condition of the fish. Application of lime improves the pond sanitation.

Harvesting

Harvesting is the collection of the fully grown fish from the pond. If the pond can be drained, the fish can be harvested by draining the pond and collecting the fish with scope nets. If the pond can not be drained repeated netting should be used to catch the fish.

Short Answer Type Question

1. Name the different types of the fish seed and write the approximate sizes of the seed.
2. Define pre-stocking management.
3. What is the desilting activity in pond preparation and write its use?
4. Name any two fish predators.
5. What is liming? Write its uses.
6. What is shirgur method of manuring?
7. Name of any two plant origin fish toxicants.
8. What are organic manures?
9. Write any one method of insect control in nursery pond management.
10. Define stocking.
11. What is post stocking management?
12. Define maximum standing crop.
14. What is stocking density?
15. What is harvesting?
Long Answer Type Question

1. Describe the pre stocking management of Nursery pond.
2. Explain the important steps involved in nursery pond management.
3. Describe the stocking pond management.

O.J.T

Students should visit the fish farm to observe.
UNIT 4

Pre-Stocking Pond Management

Structure

4.1 Introduction
4.2 Lime and its application
4.3 Manures and their application
4.4 Sanitizer
4.5 Pro-biotics
4.6 Eradication of aquatic weeds
4.7 Eradication of Insects
4.8 Eradication of Predators

Learning Objectives

After completion of this unit the student will be able to understand about

- Pond Management
- Pre-stocking, Sanitizer and Pro-biotics
- Eradication of insects and predators

4.1 Introduction

The management techniques is rearing and stocking are almost similar. To get maximum production of fish utmost care should be taken through the
good management practices. Good management so stocking ponds leads to good production of fish. The success of fish a pond depends upon careful planning. The carrying capacity of stocking pond can be increased by liming fertilization, supplementary feeding maintenance of water quality the culture of fast growing species and fish health monitoring. Pre stocking management includes liming, monitoring and eradication of aquatic weeds. Predator and insects etc.

### 4.2 Lime and its Application

Lime is frequently applied in aquaculture to improve water quality. After the pond is ploughed, cleared and smoothed, it should be conditioned with lime. Liming increases the productivity of a pond improves sanitation. It is both prophylactic and therapeutic. The main uses of lime are

(a) Naturalize the acidity of soil and water
(b) Increase carbonate and bicarbonate content in water
(c) Counteract poisonous effects of excess Mg, K and Na Ions.
(d) Kills bacteria, fish parasites and their developmental stages.
(e) Build up alkaline reserve and effectively stops fluctuations of PH by its buffering action.
(f) Neutralizes Fe compounds which are undesirable to pond biota.
(g) Improve pond soil quality by promotion mineralization
(i) Acts are general pond disinfectant for maintenance of pond hygiene.
(j) Presence of Ca in the lime speed up composition of organic matter and release CO$\text{$_2$}$ rom bottom sediment.
(k) Lime matters non-availability of K to algae.

Lime stone, calcium carbonate under prolonged heating in calculating process gets converted into quick lime of calcium oxide. This quick lime undergoes hydrolysis and changes into the calcium hydroxide or slaked lime.

Calcining process

\[
\text{CaCO}_3 \text{(Lime stone)} \quad \longrightarrow \quad \text{CaO} + \text{CO}_2 \text{(Quick lime)}
\]

Hydrolysis

\[
\text{CaO} + \text{H}_2\text{O} \quad \longrightarrow \quad \text{Ca(OH)}_2 \text{(Slaked Lime)}
\]

The most common liming material are agriculture lime stone and hydrated lime. Hydrated is the cheapest to use because it is more concentrated. Other forms of lime are ground lime stone and quick lime. In many areas, lime
stone can be found locally it is soft stone.

New ponds can be limed before they are filled with water. The limestone should be evenly spread over the dry and pond bottom. In pond with water, it is better to spread evenly on surfaced of water. Whether the pond is new or old, a layer of lime should be placed on the bottom of the pond. The lime should be added to the pond two weeks before the water is pumped into the pond. The best time for lime applications is during the period when fertilization has been stopped. Lime should not be applied while the pond is being fertilized.

Different doses of the following types of lime can be calculated as follows the cement and lining tanks.

\[
\begin{align*}
\text{CaCO}_3 \text{(g/lit)} & = Q \left(10^{-x} - 10^{-y}\right) \frac{110}{2} \\
\text{CaO} \text{(g/lit)} & = Q \left(10^{-x} - 10^{-y}\right) \frac{56}{2} \\
\text{Ca(OH)}_2 \text{(g/lit)} & = Q \left(10^{-x} - 10^{-y}\right) \frac{74}{2}.
\end{align*}
\]

Where \(Q\) is the total quantity of water (lit).

\(X\) is the PH of sample

\(Y\) is the required PH of sample of water

The highly acidic soils (PH 4-4.5) need a dose of 1000 kg/ha lime. Whereas slightly acidic soil (PH 5.5-6.5) need about 500 kg/ha. Nearly neutral soil (6.5 to 7.5 PH) requires only 200-250 kg/ha lime. The pH of the pond soil should be brought following rate for a new pond.

- Ground limestone - 1140 kg/ha
- Agricultural lime - 2270 kg/ha
- Hydrated lime - 114 kg/ha
- Quick lime (CaO) - 200 kg/ha

Quick lime must be used carefully. It can burn if it touches the skin and is harmful to the body if inhaled. Calcium hydroid and calcium oxide are best applied to the pond bottom after it has been drained.

### 4.3 Manures and their application

**Fertilization**

Fishes requires certain elements to grow and reproduce. These elements are C, H2, O2, N2, K, P, S, Ca and Mg. Some other elements called trace elements like Cu, Zn present is very low quantities the fish will not grow well. Fish get these elements from the pond soil, the pond water and the food
eat. Some fish ponds lack elements that are necessary for fish growth and productivity. In these cases, it is necessary to add fertilizers to the water. The fertilizers are simple materials which contains the missing elements. The elements most often missing or short supply in fish ponds are N, P and K. Fertilizers consisting these missing elements are added to the fish on to help the growth of the fish and the plankton, which the fish use as food.

A pond rich in phytoplankton is often bright green in colour. The colour indicates a bloom of algae. In a normal bloom, these secchi disc appear at about 30cm depth, when the secchi disc disappears at 20-40 cm depth, the pond is very productive and fertile. Not fertilizers is needed in a pond under these conditions.

Sometimes a pond can become too fertile. If the secchi disc disappears at only 15 cm, the bloom is too thick. The thick layer of green blocks the sunlight in the pond and no oxygen can be released by the phytoplankton. In the case there is too much fertilizers in the pond, and hence some of the thick layer of algae formed at the surface of the water should be removed. These ponds do not need any fertilizers.

If the secchi which determines the need for fertilizers is the quality of the soil. If the soil is highly productive, the need for fertilizers is less, if the soil is not so productive the need for fertilizers is greater.

**Type of Fertilizers**

The fertilizers which are used in fish ponds are of 2 years.

**Organic fertilizers**

These are obtained from plant and animal products such as vegetable and animal manures and household scarps. Organic manures are available at cheaper rates.

1. **Vegetables matter**

   Chopped manioc, sweet potatoes, banana leaves, napier grass and other such material have been allowed to rot for a while. This matter is used as fertilizers at the rate of 5.00 kg/ha.

2. **Liquid manure**

   Most of the animals are ureotelic which excrete, a rich source of N. It is used of sheds, where the animals are kept into ponds of mixed with other organic fertilizers cattle or pig dung.
The compositions are organic manures

<table>
<thead>
<tr>
<th>Manure</th>
<th>N</th>
<th>P2</th>
<th>K2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow Dung</td>
<td>0.60</td>
<td>0.16</td>
<td>0.45</td>
</tr>
<tr>
<td>Pig Dung</td>
<td>0.60</td>
<td>0.45</td>
<td>0.50</td>
</tr>
<tr>
<td>Sheep Dung</td>
<td>0.95</td>
<td>0.35</td>
<td>1.00</td>
</tr>
<tr>
<td>Poultry Dung</td>
<td>1.60</td>
<td>1.5-2.0</td>
<td>0.8-9.0</td>
</tr>
<tr>
<td>Farm yard Manure</td>
<td>0.50</td>
<td>0.4-0.8</td>
<td>0.5-1.90</td>
</tr>
</tbody>
</table>

3. **House holds scraps** : These are also used as fertilizers. These include garbage, rice husk, sewage, which are also called ‘night soil’.

4. **Animal Manure** : This is the most important fertilizers. Any kind of animal manure can be used as fertilizers. The important manures are cattle, pig, duck and poultry dung (Table 4.3). Organic manures are regarded as complete fertilizers because of the presence of all the three major nutrients N,P and K. The manure also consist of organic carbon, trace elements micro organisms and vitamins. These are slow acting but long lasting. Proper care should be taken in their use, other wise depletion of oxygen results in the pond water due to decay causing high mortality of fish due to asphyxiation.

**Inorganic Fertilizers**

These are chemical fertilizers. They dissolve in water quickly and provide their nutrients immediately. There are 4 major types of inorganic fertilizers.

1. **Nitrogen fertilizers** : N2 fertilizers have not given uniform results. N2 along with sodium nitrate - 16% N, Ammonium nitrate - 20% N
   - Ammonium sulphate - 20% N, Calcium ammonium nitrate - 15.5% N
   - Acidic ammonium carbonate - 16% N, Ammonium Liqour - 20 % N
   These can be applied at a rate of 200-275 kg/ha.

2. **Phosphate fertilizers** : P is required in very low quantities at the same time it is most important for enhancing fish production. Among phosphatic fertilizers single super phosphate (16%-20% P₂O₅) maintains higher levels of available phosphorus to the sol. Triple superphosphate (40%-45% P₂O₅) is more efficient in acidic soils.
3. Potassic fertilizers: Soils are rich in K, hence less amount is required in contrast to N and P. NPK is the best combination in the fertilizers. Application of 1:8:4 NPK at 500 kg/ha gave good results in nursery ponds. Now-a-days sulphate of potash ($\text{K}_2\text{SO}_4$) and nature of potash (KCI) are used in fish culture

\[ \text{K}_2\text{SO}_4 \text{ - 48% - 62% K}_2\text{O} \]

\[ \text{KCI \text{ - 47% - 50 K}_2\text{O}}. \]

4. Trace elements: The trace elements like Cu, Mn, Zn, Co, B and Mo are useful for the productivity of the pond. Mn increases phytoplankton production. Cobalt chloride is used as growth promoter.

The choice of fertilizers can be decided on the basis of physical composition of soil. In sandy or sandy loamy soils with low organic matter, fertilization is carried out with organic manures. In loamy soils with medium organic matter, a combination.

<table>
<thead>
<tr>
<th>Productivity of pond</th>
<th>N$_2$ (mg/100 of soil)</th>
<th>P (mg/100g of soil)</th>
<th>Organic Carbon (%)</th>
<th>Total of water (ppm)</th>
<th>Combination NPK fertilizers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low</td>
<td>20</td>
<td>3.5</td>
<td>1</td>
<td>50</td>
<td>300 -150-0</td>
</tr>
<tr>
<td>Medium</td>
<td>20-50</td>
<td>3.5 -6</td>
<td>1.2</td>
<td>50-100</td>
<td>200-100-0</td>
</tr>
<tr>
<td>High</td>
<td>50-75</td>
<td>6-12</td>
<td>&gt; 2</td>
<td>&gt;100</td>
<td>150-75-0</td>
</tr>
</tbody>
</table>

Both organic and inorganic fertilizer should be applied. In highly clay soil with each organic matter fertilization is carried out with inorganic fertilizers. Amount of fertilizers to be applied to ponds may be worked out on the basis of the productive potentially of the pond. The pond can be categorized on the basis of N,P organic carbon and alkalinity (Table 4.3).
In case of deficiency of potash, it can be included at the rate of 25-10 kg/ha/yr. The Np ratio should be 2:1. In addition cow dung may be applied at a rate of 10,00 - 15,000 kg/ha.yr.

The best way to use this animal manure is to make a soap of it in tank by mixing it with water. This soup should be spread in the pond. Fertilizers should be applied at a rate determined by the area of pond. Area is the length of the pond, multiplied by the width. For example if a pond measures 20 m in length and 10 m in width, it has an area of 200 square meters (m$^2$). This is equivalent to 2/100 of a hectare. To fertilize a 200 m$^2$ fish pond with cow dung, at the rate of 1000 kg/ha, you must use only 20 kg as follows:

$$X = \frac{200 \times 1000}{10,000} = 20 \text{ Kg}$$

$$\frac{200 \text{ m}^2}{10,000 \text{ m}^2} \times \frac{X}{100 \text{ kg/ha}}$$

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$$X = \frac{200 \times 1000}{10,000} = 20 \text{ Kg}$$

In pond the common rates of manures used are

<table>
<thead>
<tr>
<th>Manure</th>
<th>Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cow dung</td>
<td>10,000 - 15,000 kg/ha/yr</td>
</tr>
<tr>
<td>Pig Dung</td>
<td>5,000 - 12,000 kg/ha/yr</td>
</tr>
<tr>
<td>Chicken dung</td>
<td>5,000 - 10,000 kg/ha/yr</td>
</tr>
</tbody>
</table>

After the first application of fertilizers applications rates do not have to be high. Older ponds do not need much fertilizers because the natural life of a pond tends towards becoming more fertile. However each time the fishes are harvested they take part of the pond productivity with them. That is why older ponds are still fertilized even though they need less fertilizer than new ponds.

Fertilization should be done 2 weeks prior to stocking so that sufficient natural food is available in the pond. 1/5 of the total quantity of organic manure is required as an initial dose, and the rest is applied in 10 equal installments. Organic fertilizers may preferably by applied alternating with each other in fortnightly installments. The amount of fertilizers required in general for fish ponds is 10,000 kg/ha/yr cow dung, 250 kg/ha/yr or urea, 150 kg/ha/ye of single superphosphate and 40 kg/ha/ye of manure potash. In large ponds, fertilizers may be applied by using boats.

Multi micronutrient fertilizers are available in the market to improve the growth of cultivable fishes and prawns. These multi micronutrients mineral fertil-
izers contain an absolutely essential balanced mixture of chelated zinc, manganese, boron, potassium calcium and molybdenum. The uses of these fertilizers are

1. They act as an active stimulating agent for cell development.
2. Help in enzymatic reason as co-factor.
3. Increasing the rate of photosynthesis.
4. Increase oxygen evolving process during photosynthesis
5. Enhance active participation in both nitrogen assimilation and fixation as well as other metabolic process.
6. Help cells remain active and facilitate ion transport and exchange
7. Help in structural, functional and other metabolic integrity.
8. Enhance production of phytoplankton, zooplankton and bentic flora and fauna.
9. Boost up aqua production
10. Reduce annual production cost.

These above advantages of multi micronutrient fertilizers are very good for aquaculture in order to improve the production of fish and prawn.

4.4 Sanitizer

**Introduction**: The aquaculture sector in India emerged as an important export sector for the country. We are not only getting the food by cultivating aqua species but also getting revenue. We can enhance the above aqua species production by adopting modern scientific methods. Some of them are use of probiotics sanitizer and plant extracts etc, which are useful to maintain hygienic conditions in pond to treat the disease by which the fish, scamp and shrimp production can be enhanced. Excessive use of chemical and toxic substances adversely affected the coastal environment and there by productivity of aquaculture. Therefore safest sanitizer are like plant, extracts are applied to increase output as well as to control the environmental pollution.

Intensive aqua farming is frequently depressed by disease due to bacteria and viruses. There are various causes of development of bacteria which in for long period of decomposing evaluate toxic gases mainly ammonia, hydrogen sulfide pollute the pond. Now a days certain sanitizer are available in the markets.

**Gascon**: It is the latest concept where absorption/reduction of evolution of gases are done by growing up friendly bacteria which slowly and gradu-
ally suppress the formation of toxic gases.

**Yucca Schidigera**: Is a plant belonging to the Agavaceae family, a plant native to the desert of the United States and Mexico. It has rich in phytochemical. It is used as natural sanitizer a farming agent and as food material for live stock. It is better solution to Ammonia pollution.

**Zeolite and lime**: Are act as good sanitizer for culture ponds. They helps purification water, kills germs and improve content biological sanitizer , Deteriorative , scavengers bottom feeders are act as biological sanitizer .

**E.g**: Common carp, cirrhinmvigala and prawns are bottom feeders they acts as scavengers, common carp generally known as sanitary fish .They keep the pond neat and clean.

### 4.5 Probiotics

**Uses of Probiotics in Aqua Culture**

What are probiotics?

Probiotic is an opposite term of antibiotic where total system of environment and health of the animals are systemized interacting with friendly bacteria’s naturally occurring.

**Role of Probiotics in Aqua Culture**

It is found intensive shrimp culture frequently depressed by various disease and attacked by harmful bacteria (vibrios). The high stocking density / prawns is conductive to the spread of pathogens. Frequent use of therapeutic chemicals e.g. antibiotics though kill pathogens but does not solve the underlying problems. Slowly and gradually shrimps/prawns who are physically very much delicate succumb to microbial attack and face mortal fate.

Probiotics appeared as an alternative remedy for disease control. Aqua control is successful when there is effective interactions of the aquatic environment cultured animals and micro organisms. The effective results of probiotics are truly when mechanical devices like aeration is opted where total micro organisms fully dispersed in the pond. D.O. Level in this type of practice is maintained in heavily loaded culture ponds are hatcheries.

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Aquatic Environment

Aerators

Cultured Animals

Aqua culture Micro organisms
```
In aquaculture system the cultured animals have to adjust with complex aquatic environment where production of photosynthetic oxygen and BOD fluctuate from the atmospheric conditions in the morning day, evening and night. Fogs and clouds becomes an added loaded on the total aquatic systems which directly effects the animals the ponds. Probiotics since are friendly bacteria attempt to manipulate the factors that effect the said adverse on the cultured, organisms and try to bring the total system under control yielding healthy crops with high production.

**Pro-biotics play immense role in aqua culture they do.**

- Remove organic load of pond bottom and reduce the pollution of pond.
- Reduce the toxic gases in the pond
- Reduce ammonia level
- Improves DO
- Inhibits vibrio and other pathogenic bacteria and reduce bacteria toxins in the pond.
- Ensure healthy environment for the prawn fish and shrimp by reducing BOD and increasing DO levels.
- Reduce mortality rate of prawn fish and shrimp.

**Composition of ProBase - AR.**

Probiotics for aquaculture, usually in form of a mixture of several species and strains they are

**Group - A**

1. Bacillus subtilis
2. Bacillus itcheniformis
3. Bacillus Megatherium
4. Bacillus Polymyxa
5. Aspergillus niger
6. Apsergilus orgyzae
7. Sacchuromyces cerevsace
8. Lactobacillus sporonges
Group B

1. Alealgenes faecalis
2. Cellulomonas cartae
3. Pseudomonas denticrants
4. Psedomonas putida
5. Rhodococcus
6. Nitrobaactor
7. Nitrosomonas

Group A bacteria are having concentrating of 2.5 billion cfu/gm whereas that of group B is 2 billion cfu/lit.

On brewing in jagnry on sugar for minimum of 12 hours strength of the bacteria will be appreciably increased.

Note: Since the bacteria of group B are essential for total condition of pond soil and water and those bacterious do not survive in dry condition they have been kept in liquid.

Probities can be either applied to the feel or to the ponds.

(a) Feed probiotics: Feed probiotics are incorporated into the feed and get their way into gastrointestinal tract of the animal feed probiotics may be useful growth promoter, but for pelletized feed it is not feasible at present.

(b) Pond probiotics: In recent years, a number of probiotics have been introduced primarily for better water and pond management. They provide help for enhance the beneficial bacterial population, and removal of toxic gases such as ammonia, nitrates and other from the water and pond bottom sediment.

4.6 Eradication of aquatic weeds

The aquatic weeds (fig 6.9 and 6.10) are classified on the basis of habitual of plants, rooted weeds and floating weeds.

Rooted Weeds

1. Bottom rooted weeds: Plants are rooted at the bottom of the water and spread with in the bottom layer of water e.g. Vallisneria, Ottelia.

2. Submerged rooted weeds: The plants are rooted in the bottom
soil and the deeper margins of the pond and ramifying in the volume of water. e.g. Hydrilla, Chara, Potamogeton.

3. Marginal rooted weeds: Plans are rooted on the marginal region of the surface layer of water and ramify on the surface of water and also on the adjoining land.

E.g: Marsilla, Ipomoea, Jussiaea.

4. Plants are marginally rooted and ramifying within the marginal region of the water column.

E.g: Typha, Scirpus, Cyperus, Panium.

5. Emergent rooted weeds: Surface plants which are rooted in the bottom of the pond but their leaves float on the water level. They prefer shallow parts and shores of the pond. E.g. Nyphea (Lotus), Nyphoides, Nelumbium.
Floating Weeds

1. Surface floating weeds: The plants are floating on the surface of water and with roots in the water. E.g. Eichhornia (water hyacinth), Pistia, Lemma, Azolla, Spirodele. Few surface plants are floating on water but without roots e.g. Wolffia.

2. Submerged floating weeds: The plants are floating but submerged in the water e.g. Ceratophyllum, Utricularia.

3. We can also divide the aquatic weeds broadly as floating emergent submerged marginal weeds and algal blooms and filamentous algae.

Methods of Control

Based on the intensity of infestation and type of weeds, the aquatic weeds can be controlled by means of manual, chemical and biological methods.

Manual and mechanical method

When infestation is scanty and scattered the weeds can be controlled manually only in small water bodies. This is ancient method and is still practiced in most of the places. The pre-monsoon period (April-May) is more suitable for manual removal. In many parts of the country advantage is taken of the drought to control the weeds as ponds are other water bodies, dry up or register a sharp
fall in the water area, and the plants can thus removed. Where labour is cheap manual i often employed to remove aquatics weeds. The weeds are controlled manual by hand picking , uprooting the emergent and marginal weeds and cutting the other with scythes.

Most of the floating plants like , Pistia, Lemma, Azolla, Wolfia and Eichhornia can be effectively controlled by clearing manually with nets, whereas the marginal weeds like grass, sedges, rushes, Typha etc. May be controlled bey repeated cutting. This method does not inflict and pollution and there remains no residual toxic effects as in the case of chemical treatment or shading. The weeds thus collected should be dumped far way, be converted into compost manure or burnt so as to have no chance of reinfestation.

A number of devices ranging from very simple barbed wire rakers to sophitracted mechanical equipment like power winches steel wire, under water cutter dredger, mechanized removers etc, are in vogue to use for the purpose. Broomfork. Long fork, sickles or sycthes long knives barbed wire netting chaining and motor powered weeds cutters are some of the specialized equipment used for this purpose.

**Chemical control**

A large number of chemical weedicides are used for control of aquatic weeds. It is a very effective and cheap method. The weedicide is to be selected in such a way that it should be cheap and easily available, non toxic to fish and man, should not pollute the water and should not involve the use of special and costly equipment. The lethal action of the weedicide is either by direct contact or by translocation of chemicals from the treated part of the plant to the other areas of its system resulting in both cases in the death of the plant.

Different types of chemical are in use for eradication of weeds. Many of these are poisonous toxic or harmful and other animals. Their mode of action for the weeds are also different. The same chemicals are may not be useful for the eradication of different types of weeds.

Chemical used for eradication of weeds are broadly classified under these categories.

1. Compounds of heavy metals. e.g. Copper sulphate, Sodium arsen are etc.

2. Hormone weedicides e.g. 2,4-D, 2,4M 5-T etc.
3. Fertilizers e.g. Superphosphate Urea, Ammonia etc.

According to the mode of action, a weed chemical can also be grouped into two categories.

1. Contact weedicides-which kill plants on contact.
2. Translocated weedicides- which are absorbed by plants and killed.

The contact weedicides may be selective or nonselective killer types. The selective killer type of chemical are effective only on some specific weeds whereas the non-selective type of chemical kill types of weeds. Besides weedicides some chemical are used as soil sterilants. It shows that all chemical are not suitable for killing all types of weeds and all the chemical may not be have all qualities required for commercial use. Some chemicals are extremely poisonous for animals and human beings. Some chemical like fertilizers are required to be applied at a very high dose which is neither economical not easy to apply. The list of chemical used for control of aquatic weed is given below (table 6.4) Endothal, Endothal amine salt, 2,4-D are toxic to fish. Diqout is toxic to fish and not advocated to apply in muddy water.

**Biological Control**

Of all weed controlling measures, biological control of weeds through stocking the water with weed-eating fish such as grass carp, Ctenopharyngodon idella, is found to be and effective and satisfactory method. Grass carp is a voracious weed eater and possess strong and pharyngeal teeth, which enables it to grasp and nibble soft weeds like Hydrilla. The nature of its gill helps it to sieve large quantity of microvegetation from the water body. Because of its efficiency for weed consumption and covertibility into flesh it is preferred for stocking in weed infested waters.

Grass carp usually eat the soft part of the aquatic leaving behind the harder part like stem. It shows a certain preference for soft submerged weeds like Hydrilla, Ceratophyllum, Najas, Vallisneria. It low preference towards Ipomea is due to the hard nature which could be easily nibbled and are easily digested.

Control of weeds especially the cost submerged type of weed, through biological control by stocking the water with grass carp has certain advantages. It is not only the most economical due to low cost of operation and easy application but also does not contaminate the water with toxic substances unlike
chemical used for control. More ever it gives economical returns by increased fish production.

Common carp, Cyprinus carpio and katti, Acrossocheilus hexagonalepsis and ducks are also used for biological control of aquatic weeds. Beatles and stemborers are also recommended for the purpose.

Biological control of weeds may be done by shading. Increasing turbidity, covering the surface by controlled floating weeds, shading the water area by canvas or coloured polyethylene sheets to cut down sunlight in order to check growth and vegetation are some of the methods also in use.

4.7 Eradication of Insects

Insects are usually found in large number in ponds over the greater part of the year, especially during and after rains. These insects injure the spawn and so have to be eradicated. Hence the insects should be eradicated prior to stocking to ensure maximum survival of the span. Nottonecta, Ranatra, Cybister, Lethocoeros, Nepa, Hydrametrao and Belostoma are highly destructive to the carp seed. The insect can be eradicated by using oil emulsions. After manuring the nurseries they should be treated with oil emulsion.

The spraying of oil emulsion is 12-24 hour before stocking the spawn in nursery pond so as to eradicate the insects. The oil emulsion with 60 kg of oil and 20 kg soap are sufficient to treat one hectare of water. The soap is dissolved first in water and it is added to the oil and stirred thoroughly to get brownish grey solution. It is then spread on the surface of the water. All the aquatic insects die because of suffocation due to the thin oil firm on the surface of the water. The spiracles of insects are closed by the oil firm so that they die.

An emulsion of 56kg os mustard oil and 560 ml of Teepol os also useful to treat on hectar of water. An emulsion can also prepared with diesel boiler oil and any detergent. Since soap has become very costly one effective method is to use 50 cc of Hyoxyde -10 mixed in 5 litre of water with 50 liters of high speed diesel oil for a hector of water.

The mixture of Herter W.P. (0.6-1.0ppm) and oil extracted from plant Calophyllum inophyllum is effective to insects as well as prawns like Paleamon lamenii which is usually found in nurseries. A mixture of 0.01 ppm gamma isomer of benzene of hexachloride and ethyl alcohol is also highly toxic to insects.
Application of biodegradable organophosphate like Furnadol, Sumithion, Baytex, Dipteryx etc. (0.25 to 3 ppm) are useful to kill the insects.

Whenever an oil emulsion is applied there should be no wind as it disturb the oil film, and its effective will not be felt on the eradication. Birds like kind fishers, herons and cormorants are destructive to fry and fish. Thin lines stretched across the pond are the most effective means of controlling them.

Fig 4.3 Predatory and trash fishes of the pond
4.8 Eradication of Predators

The real problem arises during the rearing of fish, when the other animals eat the fish. Frog, snakes and birds eat young fish and must be kept out of ponds. The worst predators are carnivorous fishes, which should be prevented from entering into ponds by screening the water inlets.

The common predatory and weed fishes (Fig 6.7) in ponds are Channa sp. Clarius batrachus, Heterophenastes fossilis, Wallago attu, Netopterus notopterus, Mystus sp. Ambasis ranga, Amblypharyngodon mola.

**Table. Some Important fish poisons, dosage for fish kill.**

<table>
<thead>
<tr>
<th>Name of the chemical</th>
<th>Dosage (ppm)</th>
<th>Degraded after (days)</th>
<th>Time taken for fish kill</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bleaching powder</td>
<td>25-30</td>
<td>7-8</td>
<td>3-4</td>
</tr>
<tr>
<td>Tafadrin -20</td>
<td>9.2</td>
<td>30</td>
<td>7-8</td>
</tr>
<tr>
<td>Mahua oil cake powder</td>
<td>200-250</td>
<td>5-20</td>
<td>8-12</td>
</tr>
<tr>
<td>Derris root powder</td>
<td>4-6</td>
<td>7-10</td>
<td>6-10</td>
</tr>
<tr>
<td>Tea seed cake</td>
<td>75-100</td>
<td>10-12</td>
<td>6-12</td>
</tr>
<tr>
<td>Cotton seed powder</td>
<td>3-5</td>
<td>3-5</td>
<td>1-2</td>
</tr>
<tr>
<td>Milletioa root powder</td>
<td>2-6</td>
<td>2-3</td>
<td>1-3</td>
</tr>
</tbody>
</table>

Salmostoma SP, Esomus danricus sp etc. The weed fishes are small sized and uneconomical fishes are all usually in ponds. The undesirable fishes enter into ponds accidentally through incoming water long with carp spawn. The predatory fishes are harmful to all stages from the spawn to the adult stages of carps and prey on these carps as well as compete with them for food and space.

In any pond all trash food and predators must be removed before stocking the pond. The simple methods of draining and drying of the ponds and then ploughing them are most effective in controlling them. If the draining is not possible the pond is completely as possible the undesirable fishes should be removed from ponds by repeated drag netting. However many fishes escape the net by staying at the edges of pond. The bottom dwellers like murrels, climbing perches, magur, singhi etc., which burrow themselves in the mud are difficult to be caught by netting.
Dewatering is the best method, wherein the water should be removed by pumping, although this is an uneconomical method. In case the best way to get of the undesirable fishes is poison the water in a pond which cannot be drained.

Poisons are lethal to aquatic life even at low concentrations. It is better is use degradable poisons, so that the growing fish will not be affected later on.

**A suitable fish poison is one which is**

1. Effective in killing the target organism an fairly low doses.
2. Quickly detoxified ion water and does not have cumulative adverse effect in the pond.
3. Easily available and economical.
4. I should not injurious to the people and cattle who may use the water.
5. It should not having a tendency to accumulative in fish, this making them unsuitable for consumption.

Various types of fish poisons are available in the market. These are classified into 3 groups chlorinated hydrocarbons, organophosphates and plant derivatives. Chlorinated hydrocarbons are most toxic to fish. These are accumulated in fish tissues and are stable compounds, which are not metabolized. Organophosphate are less toxic flora and fauna. The accumulation is less in fish tissues and relatively less persistent in water. Hence the plant derivatives are good fish poisons.
Pre-stocking management aims at proper preparation of ponds to remove the causes of poor survival, unsatisfactory growth, etc., and also to ensure ready availability of natural food in sufficient quantity and quality for the spawn/fry/fingerlings to be stocked. Pre-stocking part of the management involves the following sequential measures.

It is necessary to manage the pond scientifically to give maximum yield of fish. Fish culture in ponds is basically a three-tier culture system which includes rearing of spawn up to fry (2–3 cm) stage for 2–3 weeks in nursery ponds followed by rearing of 2–3 weeks old fry for about 3 months up to fingerling stage (8–12 cm) in rearing ponds before they are finally released in stocking ponds for growing up to table size fish. To enhance the growth of fish and to increase the production, a package of management practices should be strictly followed. Prestocking management aims to ensure availability of natural food and dissolved oxygen in sufficient quantity. Pre-stocking part of the management involves the following sequential measures.
If possible, ponds should be completely sun dried. This influences the physic-chemical and biological condition of the pond by improving fertility. Drying of fish pond will kill the fish parasites and its larvae and other disease producing organisms. This will also eradicate the unwanted or weed fishes.

Fish ponds infested with weeds are undesirable and harmful for fish culture. They reduce the dissolved oxygen in water. The fishes are subjected to stress due to dissolved oxygen depletion and wide fluctuation between the dissolved oxygen values of the day and night. They also remove a large quantity of nutrients from the water, which otherwise would go into the production of planktons in the pond. Dense growth of the submerged weeds restricts fish movement and interferes with fishing operations. So, it is necessary to remove/eradicate the weeds before stocking of fish in the pond.

Before a pond is stocked, deciding which species you would like to raise and which would do best in your pond is important. The Cooperative Extension Service only recommends fish species combinations that have proven to provide excellent fishing opportunities in farm ponds (All-Purpose Option). Management practices to maintain good fishing in ponds with these species are fairly straightforward, simple and have been proven effective through years of research and experience.

There are alternative management strategies for farm pond fisheries that rely on other species and more intensive management schemes. Some of these combinations are relatively untried or work well only under certain specific conditions. Pond owners should be aware that they might need to contract with a private farm pond consultant to properly implement and maintain such alternative fisheries.

In small ponds (< 1 acre), the All-Purpose management strategy is not recommended because it is difficult to maintain a balanced predator:prey community. In these ponds, single-species fisheries tend to work best. Channel catfish only and hybrid sunfish (bream) fisheries work well in these smaller ponds.

### Short Answer Type Questions

1. Write any two uses of Lime.
2. Mention two types of Lime.
3. What is fertilizer. Write two inorganic fertilizers.
4. Name two types of organic manures.
5. What are sanitizers? Give two examples.
6. What is Probiotics?
7. Write the role of Probiotics in aquaculture.
8. Mention two surface floating weeds.
9. Mention any two submerged rooted weeds.
10. What is Predator? Give an example.

**Long Answer Type Questions**

1. Write an essay on Pre-stock Management of the pond.
2. Write about the eradication of the following
   a. Aquatic weeds
   b. Predators
   c. Insects
3. Explain the uses of time in aquaculture.
5

Water Quality Management in Ponds

Structure

5.1 Introduction
5.2 Physical factors
5.3 Chemical factors
5.4 Biological factors and their management
5.5 Water filtration and aeration

Learning Objectives

After completion of this unit the student will to understand about

- Learn and understand physio-chemical parameters of water
- Understand the biological factors play role in the water quality maintenance
- Acquire knowledge of filters and aerators in the water quality management

5.1 Introduction

Fresh water fish farming is being taken up on large the production of fisherman small farmers, and entrepreneurs same from and farm in same area and area to area. This is due to the aqua-climatic conditions and other related maintenance operations of management in connection with fresh water farming.
Out of which water quality management is one of the fundamental for fish farming. The water quality may depend upon physio-chemical parameters and other dissolved constituents of water and these are as follows.

(a) Some Physical Factors

1. Depth
   1. Temperature
   2. Turbidity
   3. Light

(b) Some chemicals

1. PH
2. Dissolved Oxygen
3. Free carbon dioxide
4. Total Alkalinity.

(c) Biological factors

1. Plankton
2. Weed
3. Disease causing agents

If the water is existing within the limitations the above cited parameters and other are called the quality water, and management is called water quality management in aquafarms.

5.2 Physical Factors

Depth

Depth of a pond influences the physical and chemical properties of water. A shallow pond allows the sunlight to penetrate up to the bottom and increases productivity by photosynthesis but if the pond is too shallow water gets heated up during summer months affecting the survival of the fish, generally two meter deep ponds are considered good for maximum productivity.

Temperature

Temperature is one of the most important factor in water quality. Temperature varies at different times of day and also during different seasons of the year, from place to place. The vertical distribution of temperature in lakes are
shown in Fig-1. It portrays direct stratification with dense cold water lying beneath lighter warm layers.

All organisms including fish possess a defined limits of temperature with the optimum lying somewhere in between. All metabolic and physiological activities and life process with as feeding reproduction movements and distribution of aquatic organisms are greatly influenced by water temperature.

Water temperature plays vital role and directly influence all the stages of fish such as

1. Induced breeding (spawning)
2. Hatching (egg to spawn)
3. Nursery (spawn to fry)
4. Culture (fry to table size)

The temperature is measured by means or mercury thermometer alcohol thermometer.

Turbidity (Suspended Solids)

The turbidity of natural water may with due to suspended inorganic substances such as silt, and clay due to plankton. Natural becomes turbid during rains and floods and by public sewages suspended solids are bits of particulate matter larger than 0.45 microns found in the water column.

Ponds with clay bottoms are likely to have high turbidity, rock basins and ponds in which sand, gravel and humus pre temporary or perennial, based on the nature of the basin and is an indication of ponds a limit, is harmful to fish and fish food organism and these are as follows

(i) Effect light reduction Suspended solids obstructs light penetration into water column and effects as following.

(a) A favorable effect is it appears in protection and excess light for light sensitive species.

(b) Unfavorable effect, it reduces the photosynthesis activity and also the primary production.

(ii) In influence the temperature directly and the fish movement in water in which solids are suspended and also results in fish kill and summer and winter, and reduces growth resistances to diseases.

(iii) Prevents the successful development of fish eggs.
(iv) Modifies the normal movements and migration of fish.
(v) Reduces the abundance of food availability.
(vi) Affects the abundance of food availability.
(vii) Influences of oxygen levels.

The turbidity is measured by means of

1. Comparison with silica standards
2. Platinum with silica standards
3. Turbidimetric methods (Jackson candle, Nephelometer).

3. Light and Transparency (Photosynthetic range 320-780 nm and transparency range 25-70 cm).

The exposure of solar radiation at the water surface marks the beginning of the photosynthetic process. Light quality are all and photo period ratio between length of day and night are all important for plant growth and may exert considerable influence to that all animals as well. The onset sexual development in animals is often related temperature but may also influenced greatly by photoperiod. In outdoor culture systems photoperiod and light intensity adjustments are not normally included in the culture strategy these factors may however be critical in the culture of indoor culture system.

Some species are active during the day light, where as other are active during night (nocturnal). Activities of the culturist such as feeding may have to be altered to confirm with the normal activity of the animals. A compete phase change in photoperiod could adversely effect growth and food conversion efficiency. Light intensity and photoperiod are of extreme importance the growth of aquatic plants also. One of the most obvious and familiar properties of water is its transparency. Natural water manifest great different in degree to which sunlight can illuminate them.

Transparency of pond water can be measured by means of SECCHI DISC method. Its value 40 cm to 100 cms is good for culture ponds and 25-50 cms for fish seed ponds.

5.3 Chemical Factors (pH Potentia of hydrogenic)

Indicate the concentration of hydrogen ions and it expresses the intensity of an acid, depending upon its dissociation as well as the total amount that is present.
Water is a weak electrolyte hence by definition a small fraction of it dissociations into the some that compose its molecule.

\[ \text{H}_2\text{O} \rightleftharpoons \text{H}^+ + \text{OH}^- \]

It can also be define as the negative logarithm of the hydrogen ion concentration is moles per liter.

Therefore \( \text{pH} = \text{Log} 10(\text{H}^+) \).

\[ \text{pH} \text{ ranges } 0.0 \text{ to } 14.0 \text{ unites ; } 0.0 \text{ to } 7.0 \text{ is Acidic range and } 7.0 \text{ to } 14.0 \text{ is Basic range (alkaline range)}. \]

\( \text{pH} \) of the pond water changes slightly due to rainfall and drastically changes due to addition of natural source like volcano water ; man made pollution that is \( \text{So}_2 \); \( \text{H}_2\text{So}_4 \); \( \text{HCL} \); \( \text{HNO}_3 \) etc. Occurs in natural water decreases drastically it can be controlled by addition of sufficient quantity of lime.

Sometimes \( \text{PH} \) volume increases or decreases due to (edaphic factors i.e. soil contains mines of calcium etc., and main like pyrite \( \text{feS}_2 \)). If \( \text{pH} \) value increases beyond the limit and it can be controlled by addition of organic manures or application of mustard oil cake 800-1200 kg/ha or culture of \( \text{Azolla}\).

Swingle. 1967 stated that water having a range of 6.5 - 9.0 as recorded day break are most suitable for pond culture and those having \( \text{PH} \) values of more than 9.5 a unsuitable because the latter \( \text{CO}_2 \) is not available fish dies at about \( \text{PH} = 11.0 \). Acid water reduces the petite of the fish their growth and tolerance to toxic substance. Fish gets prone the attacks of parasites and disease in acid water.

\( \text{pH} \) can be measured by means of

1. Colour comparison in LOVIBOND comparator.
2. Electromatically in \( \text{PH} \) meter.

**Free Carbondi oxide**

The earth atmosphere contains relatively small amount of carbondi oxide. The global average being approximately 0.032% by volume as of 1970 (Machta 1973). Despite the small proportion of \( \text{CO}_2 \) among the gases of the air, it is relatively abundant in natural water. Owing mainly to its high co-efficient of solubility. \( \text{CO}_2 \) is very much soluble in water about 200 times greater than oxygen solubility.

**Sources of \( \text{CO}_2 \) in inland water**

1. Rain water (Rain water contains 0.3 to 0.6 ppm dissolved \( \text{CO}_2 \)).
2. Water passes through organic soil and streams.
3. Respirations of animals and plants.
5. From the atmosphere.

The fate of Co\textsubscript{2} in water

When Co\textsubscript{2} enters pure water, a small proportion of it (below 21\%) is hydrated to form carbonic acid.

\[ \text{CO}_2 + \text{H}_2\text{O} \leftrightarrow \text{H}_2\text{CO}_3 \quad (1) \]

Some of this carbonic acid dissociates into carbonate and hydrogen ions, bringing about a lowering of the pH. This is a typical occurrence when Co\textsubscript{2} is dissolved in water.

\[ \text{H}_2\text{CO}_3 \leftrightarrow \text{HCO}_3^- + \text{H}^+ \quad (2) \]

A pH rises, reaction (2) goes to the right and dissociation of carbon begins to assume importance at about 6.4 Gaseous CO\textsubscript{2} and H\textsubscript{2} CO\textsubscript{3} decrease until they are no longer analytically present at about pH \( \approx 8.3 \) the turning point of the indicator is phenolphthalein. Below OH 8.3 phenolphthalein is colourless, it is pink at the pH 8.3 and above.

\[ \text{HC}O_3^- \leftrightarrow \text{H}^+ + \text{CO}_3^- \quad (3) \]

The forms of Co\textsubscript{2} in water

In most natural waters gaseous Co\textsubscript{2} occurs in the presence of alkali metals or alkaline earth metals and combines with them to form the bi carbons and carbonate as discussed earlier. If calcium is used as an example, it is possible to describe an equilibrium relationship for its salts.

\[ \text{Ca} (\text{HCO}_3^-)_2 \leftrightarrow \text{Ca} \text{CO}_3 + \text{CO}_2 + \text{H}_2\text{O} \quad (1) \]

(Calcium bicarbonate) calcium free monocarbonate Co\textsubscript{2}

This reaction indicates that carbon dioxide has three important forms in waters; the bound state represented by the bicarbonate ion, the bond form represented by monocarbonate and free dissolved gas.

Rawson (1939) states that Co\textsubscript{2} “STANDS AT THE THRESHOLD OF ALL PRODUCTION”.

Photosynthesis is the process by which carbon dioxide is converted to organic compounds in presence of sunlight, chlorophyll and certain enzymes.
Effect on fish

A high CO₂ content of water is lethal to fish life. It prevents the oxygenation of water and it might also adversely affect the extraction of dissolved oxygen from the water. Based on observation it may be equal to 7.0 ppm is the lethal limit for healthy fish life.

Estimation of Free CO₂

Free CO₂ is estimated by titrating with dilute NaOH (N/44) is the presence of Phenolphthalein indicator (APH, 1975).

The capacity of natural water system to resist changes in PH can be measured in terms of the amount of bicarbonate and carbonate ions that are available in the system, this measurement is called alkalinity.

Alkalinity commonly results in carbon dioxide as water attacking sedimentary carbonate rocks and dissolving out some of the carbonate to form bicarbonate solutions. If Me denotes an alkaline earth metal, such as calcium, magnesium, sodium, potassium etc.

\[
\text{MeCO}_3 + \text{CO} + \text{H}_2\text{O} \rightleftharpoons \text{Me}_2 + 2\text{HCO}_3 \quad \text{(bicarbonate)}
\]

\[
\text{HC}0_3 + \text{H}_2 \rightleftharpoons \text{H}_2\text{CO}_3 + \text{DH} \quad \text{(Carbonate)}
\]

Natural water also contain additional negative ions the reacts hydrogen ions, thus there as buffer other than the salts of carbonic acid. The other buffer system are Borate buffer system phosphate buffer system. The pH of the water effects the percentage alkaline contributed by carbonic acid, bicarbonate and carbonates, Temperature and salinity also affect these relationship. Natural water bodies of the tropical usually show a wide range of fluctuations in total alkalinity values depending upon the location, season, plankton population nature of bottom deposits etc.

Alkunhi (1957) stated that in highly productive water, the alkalinity caught to be over 100pm. In aquaculture system the alkalinity should be between 80 to 200 pm in fresh water.

Estimations of Alkalinity

Alkalinity is measured by titrating water samples with dilute sulfuric acid to an end points indicated by phenolphthalein and methyl orange.(APHA, 1975).
Dissolved oxygen

Oxygen is the most fundamental parameter to all water bodies aside from water. Dissolved oxygen is essential for the metabolism of all aerobic organisms. Therefore the information on the solubility and the dynamics of oxygen distribution in water bodies is basically important for understanding the distributing behavior and physiological growth of aquatic organisms.

The determination of dissolved oxygen (DO) in the aquatic environment is among the most important factor in the water quality management in aquafarms. If sufficient level of the DO is not maintained animal will succumb to stress and becomes vulnerable to disease and parasitic outbreaks leading to their death. At the very least the animal may refuse to eat for a period during and after an oxygen depletion, thus growth rate is retarded.

Source of Oxygen

1. Atmosphere
2. Photosynthesis

Loss of Oxygen

1. Respiration
2. Decay of aerobic bacteria
3. Decomposition of dead decaying sediments.

Oxygens depletion may be controlled by the following methods.

1. Exchange of water
2. Artificial aeration
3. Spraying water over the surface of ponds or agitation of surface water.
4. 5 ppm of potassium permanganate solution spraying over the pond surface.

Estimation the dissolved oxygen is by Winklers method of electrical analyser.

The water characteristics ideally suited for fish farming.

<table>
<thead>
<tr>
<th>S.NO.</th>
<th>Parameter</th>
<th>Level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Temperature Air</td>
<td>24-380c</td>
</tr>
</tbody>
</table>
2. Temperature Water 25-350°C
3. Transparency 25-70 cm
4. pH 6.5 - 8.5
5. Dissolved Oxygen 4.0 - 8.0 ppm
6. Free Carbon dioxide 0.0 - 16.0 ppm
7. Total Alkalinity 40.00-200 pm
8. Free Ammonia Less than 0.5 ppm
9. Phosphate 0.6 - 0.1 ppm
10. Iron Less than 0.01 ppm
11. Zinc Less than 0.01 ppm
12. Mercury Less than 0.01 ppm
13. Copper Less than 0.01 ppm

Vertical temperature profile showing direct stratification and the lake region defined by it.

5.4 Biological factors and their management

The biological factor like plankton, weeds and disease causing agents also play a role in water quality maintenance.

Plankton-Water quality

Plankton are free living smaller plants and animals, which move along the waves. Plankton are natural fish food organism. Which consist of 69% easily digestable proteins. Phytoplankton produce food and O2 by photosynthesis. Plankton density variations depend upon the fertilizers and fish species cultured. Carbon dioxide H2, P, N2, S Fe, K, Ma,Mn, Zn, B and C12 are essential for plankton production out of these N, P, K, are most important elements for plankton production.

To increase plankton production organic and inorganic fertilizers should be used. Lime is also essential for plankton production. Fertilizers and lime should be regular intervals. This helps in production in sufficient quantities. Excess production of plankton, especially myxophyceae members settle on the
water surface and form algal bloom. This hampers photosynthesis and oxygen depletion is observed especially during nights, CO2 levels increase in the pond and affect water quality.

### 5.4.1 Disease Causing agents - Water Quality

The most important aspect of water quality management in the culture system is to maintain fish without disease causing agents and under hygienic conditions. The disease is fishes and prawns are caused by bacteria, virus, fungi, protozoa and helminth, and crustacean parasites. These parasites enter into pond along with water, fish or pawn seed and nets from other infected ponds. Due to the hygienic conditions these parasites cause disease in fish prawns, the fish and prawns become less resistant to disease. Due to parasitic infection and growth rate reduces and finally they die. To avoid these bad effects use good and healthy material and fish and finally should be examined once in 15 days. Abnormal behavior of fish and prawns is observed in infected. These should be observed and immediate action should be taken otherwise whole crop could be wasted/destroyed.

### 5.4.2 Aquatic weeds-water quality

Excess growth of aquatic water in fish pond is not good sign in aquaculture systems. Weeds utilize the nutrients and compete with desirable organism. Weeds also compete for oxygen, especially during nights and space with fishes. They obstruct the netting operations too. Hence the weeds should be removed from ponds by mechanical, chemical or biological methods.

Applications of lime fertilizers ad feed are some of the important measures to maintain the water quality. These should be applied whenever required. Excess application leads to poor condition of water quality.

### 5.5 Water Filtration and Aeration

#### Role of aerators in the water quality management

Atmosphere oxygen dissolves in the water surface. In this layer dissolved oxygen quickly but not at the pond bottom. To get oxygen even in the bottom layer, the pond water should be disturbed. To gets this surface are very essential. Aerators produce the air bubbles, which disturb the water in the pond, so that more oxygen dissolves in the water. Aerator therefore play a vital role in aquaculture to increase fish and prawn production.

Different types of aerators are in operations to increase aeration in the ponds. Diffused air lift pumps U-tube and splashers are some of the common aerators (Fig 6.11) in operation in aquaculture.
In diffused type the blower or compressor is arranged on the dyke, and this to connected to a porous which as arranged on the pond bottom. Compressor produces air, which comes out of the porous tube in the form of air bubbles and disturbs the water to produces more dissolved oxygen. The capacity of the aerator depends upon the compressor energy and pond depth.

In air lift pump aerator air sent into a tube, which opens on surface of water. Air bubbles travel through the tube and enhances the dissolved oxygen. This aerated water falls on water surface and increases dissolved oxygen water further.

In U-tube aerator the U-tube has 12-18 meters depth. At one end air is pumped with the help of blower and the air bubble travel to the other end i.e. air bubbles have more contact lime with water. These aerators are more efficient but need more expenditure for construction.

Splasher type of aerators are also known as surface aerators. Propeller of the aerator is arranged near the water surface and water is sprinkled which helps in enhancing the oxygen in the pond. Paddle wheel surface aerator are also sued in fish ponds. Sprinkles are used in fish ponds where porous pipes are arranged on the water surface and pump the air is pumped with engines into the pipes. This gives aeration in the pond and produces successful results (such as those obtained in Kolleru area).

5.5.1 Role in filter in the water quality management

Aquatic culture systems contain living organism in water. These organism require inputs such as food any they excrete other material. The inputs must be mixed with or dissolved in water to be available to the organism, whose output will also become mixed with or dissolved in water. Excessive output and or/input can become toxic of excess material is allowed to increase in the culture water. The process of removing layer of sand and gravel which act as strainers. Suspended and colloidal matter in the water and also a large number of bacteria are caught in the interstices of the sand during its passage.
The mechanical biological and airlift are generally adopted in aquaculture practices to manage and control the water quality for intensive rearing and culture.

**Mechanical filter**

A mechanical filters (fig 5.2) is an under drained water tight basin in which the filtering materials are placed. The size of a mechanical slow and sand unit may be about 30 to 60 x 16 to 30 m or more and about 2.5m to 3.5m deep according to which is equipped with a flow regulating arrangement. The filtering about 90 cm to 150 cm of which about 60 cm is fine sand, s laid on top of the under drainage system in five or six layer in progressively smaller sizes towards the tops.
(a) Mechanical filter

(b) Air lift filter

The sand is supported on two or three layer of graded, with the finest layer immediately below the sand the corset material at the bottom of the filter, packed around the drains. The gravel must be graded at the bottom of the filter, packed from mixing and the sand being drawn down.

The following thickness may be taken for the filtering material from the bottom towards the top.

1. 10 cm to 15 cm broke stone 40 mm to 65 mm size.
2. 8 cm to 15 cm gravel 20 mm to 40 mm size.
3. 5 cm to 10 cm gravel 3 mm to 6 mm size.
4. 15 cm to cm go gravel 3 mm to 6 mm size.
5. 60 cm to 90 cm of fairly fine sand.

When the resistance in the filter (due to sand and clogging) i.e. loss of head is equal to the total depth of water the operation will stop. The loss of head should not be greater than be depth of the filtering sand. When it becomes and before an negative head is formed the filter should be cleaned. The level of the filtered water at the outlet chamber should not be below the level of the surface of the filter sand.

The rate of filtration is 120 filter per minute when the graded layers are V sand of 0.05 to 0.1 m, 6 sand to 0.1 to 0.5 mm, 6 gravel 2 to 5 mm 1 metal 5 to 10 at the total filtering surface area of 144 square feet.

**Biological filter**

It comprises the mineralization or organic compounds nitrification and denitrification by bacteria suspended in the water and attached to the gravel the filter bed.

Heterotrophic and autotrophic are the major groups present in culture systems. Heterotrophic species utilize organic nitrogenous compounds exerted by the animals as energy sources and convert them into simple compounds such is ammonia. The mineralization of these organics is the first stage in biological filtration. It is accomplished ion two steps; ammonification which is the chemical breakdown of proteins and nucleic acids producing amino acids, and organic nitrogen base and deamination in which a portion of organic and some of the produces of ammonification and converted to inorganic compounds.
Once organisms have been mineralized by heterotrophs, biological filtration shifts to the second stages which is nitrification. It is the biological oxidation of ammonia to nitrite and then to nitrate by autotrophic bacteria. Those organisms unlike heterotrophs require an inorganic substrate source and utilize carbon dioxide as their only source of carbon. Nitrosomonas and nitro batter species are the principal nitrifying bacteria in culture systems.

Nitrosomonas oxides ammonia to nitrate. Nitro batter oxides nitrite to nitrate. The third and last stage in biological filtration is denitrification. This process is a biological reduction of nitrate to nitrate to either nitrous oxide or free nitrogen. Denitrification can apparently be carried out by both heterotrophic and autotrophic bacteria.

**Air lift filter**: It is the most efficient water filtering device. In culture application lift pipe extends below water level and the filter chamber rests above the top water surface. The suspended or colloidal impurities up to the size of 0.002 mm can be filtered out through this system. By pumping 5 cm air/sec/2 liters of water per minute can be filtered when the diameter of lift pipe is 1 cm.

### Short Answer Type Questions

1. Name some physical factor of water quality management.
2. Name any four chemical factors of water quality.
3. Write the effect of temperature on aquatic organism.
4. Define ‘turbidity’ and how the turbidity measured.
5. What range of transparency is suitable for fish culture? How it is measured.
6. Define pH what is the suitable range of PH for aquaculture.
7. How can you measure the PH of water.
8. Write the equation of photosynthesis.
10. Write the source of dissolved oxygen.
11. Write any two control methods or oxygen depletion.
12. By what method you can estimate the dissolved oxygen in give sample water.
13. Write any two parameters of water and their ideal levels.
14. What are the biological factor in water quality management.
Long Answer Type Questions

1. Describe the any three important physical parameters of culture ponds.
2. Describe any three important chemical factors.
3. Write short note on following.
   (a) PH
   (b) Dissolved oxygen
   (c) Alkalinity
   (d) Co2
4. Write the role of biological factors in water quality maintenance.
5. Write the role of aeration in water quality management.
6. Write importance of filtration in water quality management.

O.J.T

Determination of physio-chemical parameters of water.
UNIT 6

Feed Management

Structure

6.1 Introduction
6.2 Food and feeding habits of fish
6.3 Food and feeding habits of prawn
6.4 Natural food organism in pond
6.5 Nutritional requirements
6.6 Supplementary feed and their application
6.7 Signification of plankton and their culture
6.8 Bio-enriched feeds
6.9 Feed attractants

Learning Objectives

After completion of this unit the, student will able to

- Understand food and feeding habits of fish and prawn
- Know the knowledge of natural food organism in pond
- Learn the nutritional requirements of aquatic organism
- Know the importance and application of the supplementary feed
- Know and learn the culture of plankton
• Understand the bio-chemical feeds and feed attractants

6.1 Introduction

One of the most important features of fish culture in that the fish should have good food. Feeding and fertilization together make the pond culture successful. The growth of fish in the ponds is directly to the amount of food available in the pond. The pond must provide all the food nutrients that the fish need. But all of not need the same kind of food. For different species feed on differently types of food. Fish also feed on different foods depending on the stage of their life cycle.

Newly hatched hatchlings absorb feed form their yolk and until the yolk in the yolk sacs is exhausted. The fry eat the smallest phytoplankton in the pond. Adult fish feed on a particular kind of food that fish enjoy plankton, aquatic weeds, worms insect larvae etc.

As the aquaculture technology evolved, there has been a trend high yields and faster growth of fish. It is necessary to enhance the food supply by fertilization., supplementing the food with artificial feed or providing all the nutrients to fish in a cultivating field. As the fish becomes less dependent on natural food organism and more dependent on artificial food, the need for nutritional feed becomes necessary.

6.2 Food and Feeding habits of fishes

Different author have classified natural food and feeding habits of the fishes (Schaprclas 1933).

1. Main food : It is the most preferred food on which the fish will thrive best.

2. Occasional food : It has relatively high nutritive values and is liked and consumed by fish whenever the opportunity presents itself.

3. Emergency food : It is fed/upon/accepted when other of food on the basis of their importance in the diets of fishes.

Nikolsky (1963) recognized 4 main categories of food on the basis of their importance in the diet of fishes.

Basis Food : It is normally eaten by the fish and comprises most of the gut contents.

1. Secondary food : It is frequently consumed in smaller quantities.

2. incidental food : It is consumed rarely.
3. **Obligatory food**: The fish consumes this food in the absence of basic food.

Based on the nature of food, Das and Moitra (1963) classified the fisher into 3 primary groups.

1. **Herbivorous fishes**: They feed on plant material, which forms more than 75% of gut contents.

2. **Omnivorous fishes**: They consume both plant and animal food.

3. **Carnivorous fishes**: They feed on animal feed, which comprises of more than 80% of the diet.

Herbivorous are divided into 2 sub groups.

(a) **Planktophagous fishes**: They consume only phyto- and zooplankton.

(b) **Detritophagous fishes**: They feed on detritus.

Omnivorous can also be grouped into 2 categories

(a) **Herbi-omnivorous**: Fish feed more on plant material than animal food.

(b) **Carni-omnivorous**: Fishes feed more on animal food than plant material.

Carnivorous are also classified into insectivores (feed on insects) carcinophagous (feed on crustaceans), malacophagous (feed on molluscs), piscivorous (feed on other fishes) and larvivorous (feed on larvae). Some fishes are cannibalistic.

The fishes consume a variety of food material, such as phytoplankton, zooplankton aquatic weeds, animals like annelids, arthropods, molluscs, other fishes and amphibians.

### 6.3. Food and Feeding of prawns

A wide range of feeding habits have been noticed in prawns in nature during their developing stages. The nauplius larvae do not feed at all as they depend on yolk reserves. But protozoa larvae food voraciously on minute food organism, mainly phytoplankton viz. Skeletoneria, Chaetoceres etc. As their oral appendages are not full developed for the capture for larger food organisms, and they have a simple alimentary system. The myosis stage starts feeding small feeding on small animal food organisms, occurring plenty in the ecosystem. During the postal larval stages, which follows the myosis stage the mouth
parts on chelate legs are fully developed, and from now on, the prawn larvae are capable of feeding on a variety of animals as well as vegetables matter.

They then settle down to the bottom and browse on the substratum. Penaeus indicus has been reported to feed on plant material in the younger stages while the older ones prefer predominantly crustacean diet. Algal filaments also form part of the food of this species. P monodon feed on molluscs, crustaceans, polychaetes and fish remains. P. Semisulactus consume large quantities of animal matter viz. Polychaetes, crustacean, molluscs, foraminiferans and fishes. Controlled fertilization of culture ponds stimulates the growth algae zooplankton and in turn some of the bottom dwelling animals which are known to be the food of prawns.

The natural food of larvae form myosis stage onwards consist mainly of zooplankton such as veliger, trochophore, rotifers, copepods, very small worms and larval stages of various aquatic invertebrates. In the absence of live food, minute pieces or organic material especially those of animal origin (fish, prawn, crab, molluscs etc.). Are readily eaten.

6.4 Natural food organism in pond

A variety of natural fish food organism are found in water body, which depend on the nutritive nature of the water body. The natural food provides the constituents of a compete and balanced diet. The demand of natural food varies from species to species and age group of individuals. For example catla prefer zooplankton and silver carp prefers phytoplankton. At younger stage, the fish may feed on plankton, and the same fish may prefer animal food as an adult. Fishes are on different natural food organism at all the different trophic levels. Natural feeds have high protein and fat contents which promote the growth of the fish. Hence, it is necessary to increase the live food in the aquatic ecosystem to improve the growth to improve the growth of the fish.

6.4.1 Plankton

Fish production in water body is directly or indirectly dependant on the abundance of plankton. The physcio-chemical properties of water determines the quality and quantity of plankton. Thus during the study of plankton, a link in the food chain is pre-requisite to understand the capacity of the water body to support the fisheries and the need for introduction of additional selected species of commercially important fishes.

Phytoplankton

Fishes consume the phytoplankton which is found abundantly in well managed ponds. Phytoplankton gives green colour to the water due to the pres-
ence of chlorophyll. Plankton are generally made up of mostly unicellular algae which are either solitary or coronial. Phytoplankton are autotrophs. Algae of three major classes which from the main food in phytoplankton (fig 6.1.3). These are chlorophyceae, cyanophyceae and bacillariophyceae.
6.4.2 Chlorophyceae

These are called green algae due to the presence of chlorophyll. The chlorophyceae members useful as fish food are Chlamydomonas, Volvox, Eudorina, Pandorina, Chlorella, filamentous algae like Ulothrix Oedogonium, Spirogyra, Pediastrum, Microspora, Cladophora, Clostridium, Scenedesmus, Cosmarium etc.

2. Cyanophyceae: These are also called as myxophyceae and are commonly known as blue green algae. This colour is due to the varying proportions of chlorophyll, carotenoids and biliprotiens, cyanophycean members are consumed by fishes. These are Nostoc, Oscillatoria, Anabaena, Microcystis, Spirulina, Merismopedia, Arthrospira etc.

3. Bacillariophyceae: These are called diatoms. They are unicellular organisms with different shapes and sizes. These may be yellow or golden brown or olive green in colour. The reserve food materials are fat or volutin. The diatoms consumed by fish are Diatoma, Navicula, Cocconies, Synedra, Tabellaria, Meridion, Fragilaria, Nitzschia, Pleurosigma, Amphioleura, Rhiszoslenia, Cyclotella, Amphora, Melosira, Achnanthes etc.

Zooplankton

Plankton consisting of animals is called zooplankton. Zooplankton is abundant in the shallow areas of water body.
Protozoa

Protozoans are most primitive unicellular and microscopic these organism are provided with locomotory organella like pseudopodia, flagella and cilia. These organism are found abundantly in fish ponds are useful as natural fish food

The protozoa with pseudopodia.

The protozoans with flagella.

The protozoans with cilia.

6.4.3 Crustacea

The aquatic animals with 19 pairs of appendages and branchial respiration are included in the class crustacea. The crustaceans vary form microscopic to large animals. Crustacean form major component of zooplankton. In zooplankton the micro crustaceans are useful as food of fish and prawns. The
important micro crustaceans are copepods and cladocerans. The crustaceans nauplii also constitute good food material for many fishes and prawns. For example, nauplii of Artemia are used in prawn hatcheries.

(a) **Copepoda** : These are animals with 5 pairs to thoracic appendages, abdomen without appendages, forked telson, two pairs of antennae and body with head thorax, and abdomen. The copepods inhabit many of the freshwater habitats such as lakes, reservoirs, ponds etc. The sizes of the body of the copepods is 0.3 to 3.5 mm. Copepods such as Cyclops, Mesocyclops, Diaptomus, Canthocamptus etc, are useful as fish food organism.

(b) **The animals** : Which are bivalved should shaped with or without shell, flattened trunk appendages and leaf-like caudal styles which may be unjointed or jointed are included in cladocera. The greatest abundance of cladocerans is found near the vegetation in lakes, ponds etc. The size of these shelled crustacean varies from 0.2 to 3.0 mm. The cladocerans like Daphnia, Ceriodaphnia, Moina, Sinocephalus, Scapholebris, Sida, Eurycerus, Chydorus, Daphniosoma, Polyphemus, Macrothrix, Leydigia etc are useful as fish food organism.

(c) **Ostracoda** : The animals with bivalved carapace, which encloses the entire body, 4-6 trunk appendages and reduced trunk are included in ostracoda. These forms are well represented in both standing and running waters. These are exclusively planktonic forms. Occasionally like Cypris, Stenocypris etc, are consumed by fish.

**Rotifera**

Rotifera are readily from other planktonic material by the presence of their major ciliated wheel-like structure called corona and hence they are called wheel animalcules. Rotifers live in a variety of aquatic habits. They are microscopic, ranging from 40 microns to 2.5 mm in size. Usually rotifers like Keratella, Phlodina, Rotaria, Hexarthra, Filinia, Brachionus Epiphanes etc., are useful as food organism.

1. They are nutritious and their actual nutritional value can be improved, as can be done for other zooplankton, by packing the rotifers with specific strains of algae or other feed.

**Aquatic weeds**

Though the aquatic weeds form undesirable vegetation, which cause damage to the fisheries these are helpful as food a few fishes. Many herbivorous fishes consume aquatic weeds. The grass are si a fast growing fish that feed on aquatic weeds. This fish utilizes submerged weeds like Hydrilla, Najas,
Ceratophyllum, Ottelia, Nechamandra, Vallisneria in that order of preference. The young fish prefer smaller floating plants like Wolffia, Lemna, Azolla and Spirodela the other herbivorous fish utilize aquatic weeds are Pulchellus. Tilapia and Eptroplus. Though and omnivore common carp feed wheel on filamentous algae like Pithophora and Cladophora. Trichechus sp., a large air-breathing herbivore, is being utilize for clearance of aquatic weeds in the canals of Guyana.

The detail account of aquatic weeds is given in chapter VID.

Annelids

Animals with metameric segmentation, eucocel, nephridia and setae are included in the phylum annelida. The animals which belong to classes polychaeta and oligochaeta are useful as fish food organism. These are found at the bottom of the water body are generally consumed by bottom-dwelling fish. Common carp, catfishes, murrels, etc. Tubifex, Glycera and earth worm are the common fish food oligochaetes.

Insects

Animals with 3 pairs of legs of wings, jointed appendages and a chitinous body wall are included in class Insecta. Insects and their larvae form main food item of any fishes. Aquatic insects are often preyed upon by fish trout, catfishes murrels etc. Hemiptera, diptera, coleoptera, ephemeroptera and plecoptera insects dominate as fish food among the insects. Belostomatidae and notonectidae and nymphs to odonata and fish food organisms. Larvae of may flies, dragonflies, chironomid larvae chaoborus larvae and mosquito larvae and also found commonly in fish diets. When may flies constitute the diet of trouts, it has been observed that the trout are fatter and better flavored.

Mollusca

The animals with a soft body, shell and foot are included in the phylum Mollusca. The molluscs are found at the bottom of water body. Hence only bottom-dwelling fish consume them. The gastropodes are found in the diet of carnivorous and omnivorous fishes.

Amphibia

Amphibian are tetrapodes, terrestrial as well as aquatic. The fishes consumes only anuran larvae the tadpoles among amphibians. The consumption of tadpole larvae is not frequently found.

Fishes

Carnivorous (piscivorous) fish feed on a variety of other adult fishes,
fish egg fry an fingerlings. Fish like murrels, freshwater shark, seenghala, etc, feed on other fishes. The small fishes are like Salmostoma, Amblypharyngodon, Puntius, Labeo, chanda, Nuria, Lebistis, Gambusia, Esomus etc are consumed as food by larger fishes. Some fishes are cannibalistic in nature.

**Prawns**

Fishes are also feed on decapods (prawns). The carnivorous and omnivorous fishes feed on small prawns. For example, Macrobrachium Kitsuensis is found the gut is many fishes. Acetus prawn suspension is given as food to the larvae and post-larvae of prawns in the hatcheries.

### 6.5 Nutrient Requirements

As fish and shrimp farming continues to expand, production methods have shifted from traditional extensive to semi-intensive or intensive system utilizing modern facilities, equipment and management techniques aimed at producing higher yields per unit area. Natural food constitutes an important source of nutrients for intensive culture. Whereas artificial feeds are required for semi-intensive and intensive practises. In intensive culture systems, feed represents the major expense, often accounting for over 50% of total variable operating costs. This the development of feeds that are efficient and economical is fundamental to successful shrimp farming. This requires the understanding of nutritional in items of protein, lipids, carbohydrates vitamins and minerals.

**Proteins and amino acids**

As the principle and most expensive component of diets, protein has received the maximum attention in nutritional requirement studies. Animals including fish and shrimp must consume protein to furnish a continuous supply necessary for replacing worn tissues and for the synthesizing of new tissues. Inadequate protein in the diet will result in retardation or cessation of growth, or loss of weight due to the withdrawal of protein from less than vital in order to maintain the functions of more vital done. If too much protein as supplied, however only a part will be used to build new tissues and the remainder will be converted into energy.

**6.5.1 Carbohydrates**

In fish carbohydrates is present in lower quantities in the form of glycoogen sugars and their derivatives. In fish carbohydrates such as sugar, starch, gums and cellulose are digested and the products of their hydrolysis are taken to the tissues through blood circulation and serve as immediate energy sources. Carnivorous fish do not digest raw starch owing to their inherent digestive capacity due to weak carbohydrates. On the other hand, herbivorous especially
grass carp, have the ability for rapid and efficient digestion of plant fibres and raw starch due to their cellulose and didastase enzymes. It is observed that 10-50 percent of carbohydrates in fish feed enhances the growth of fish through their protein sparing action. However, the excess of carbohydrates when present in fish diet is either stored in the liver and muscle as glycogen or converted into visceral and muscular fat.

6.5.2 Fats

The fats and oils are high energy-yielding substances. The fat requirement of any culturable fish depends largely on its digestibility, quantity, amount of essential fatty acids present in the fat and the level of the fat can tolerate. Fish feed of profitable fish culture should have 4-18% of fat, and excess lipid in the diet may affect the fins, liver body colour growth rates of fish and may lead to mortality in culture system. The gross conversion efficiency of fat is about 90%. The fat acids and esters of glycerol are used by fish for long-term energy requirement, particular during period of extensive swimming and inadequate food supply. Fresh water fish have higher level of poly-unsaturated fatty acids compared to their marine counterparts. Hence, marine fish require more poly-unsaturated fatty acids in their diet.

6.5.3 Vitamins

Qualitative and quantitative vitamin requirements for several commercially important finfish species such as salmon, Trout, channel catfish and common carp have been fairly well-defined but vitamin information for shrimp is very limited. However, the importance of vitamins in penaeid shrimp nutrition has long recognized as these nutrients have normally been included in experimental or production diet. The amounts of vitamins added have been varied due to lack of established requirement data.

Thirteen vitamins, three fat-soluble vitamins (vitamins A, D, and K) and ten water soluble vitamins (thiamin, riboflavin, Pyridoxine, nicotinic acid, biotin, folic acid, vitamin B12, inositol, choline, and vitamin C) have been shown to be dietary essential for shrimp based on weight gain. Survival rate, tissue storage and other specific deficiency sings.

Among the vitamins thiamine and pyridoxine and important role in growth of herbivorous and carnivorous fishes respectively. Further more, vitamins such as A, K and E are essential for the growth and maturity of salmonids. Similarly, vitamin D has growth promoting effect on fish. Vitamin C in fish, feeds on the other hand is reported to be an important ingredient in diets of young fish, which when they are in high densities cause nervous excitation and limited muscular movements.
6.5.4 Minerals

Minerals have many important functions in the animal body. They are essential components of hard tissues (bones, teeth and exoskeleton), soft tissues (protein and lipids), vitamins, enzymes, hormones, and respiratory pigments. They are also required for the maintenance of osmotic pressure, acid-base balance (e.g., regulation of blood pH, haemolymph, urine, and other body fluids) and the proper functioning of muscles and nerves.

Minerals are required in small quantities in the diets. Though minor in quantities added, the mineral nutrition is no less important. These are very essential to be supplemented in fish diets because fishes are not capable of synthesizing them. Many minerals either through feed or from the environment cause significant loss in unit of flesh production. Minerals not only provide basic skeletal structure but also are important cofactors of enzymes and other biological chemical involved in life processes. Since fish need to maintain their osmotic balance through mineral requirement in fish may be classified as bulk elements (such as calcium, phosphorous, potassium, chlorine, sodium, magnesium) and trace elements (copper, cobalt, iron, iodine, manganese, selenium, zinc, aluminium, chromium, and vanadium).

6.6 Supplementary feed and their application

In the raising of stable fishery, there is a need for regular supply of sustained and balanced food for growing fish. Suitable food has to be provided for healthy growth of fish. Special food arrangement is required for raising good crop of quality fish, often very necessary. However, artificial feeding of fish in rearing and stocking ponds might be economical in India at present. Some fattening food may however be desirable a few days before harvesting and marketing fish. To ensure sustained growth, artificial food has to be supplemented at times of natural food scarcity in ponds.

The feed which is added in the pond for better growth of fish in supplementary food. The typical supplementary food are rice bran, ground nut oil cake, bread crumbs fish meal, maize powder, broken rice, soybean cake, peanut cake, corn meal, cotton seed oil cake, oats, barely, rye, potatoes, coconut cake, corn meal, cottonseed grass, wheat, silkworm pupae, left over animal feeds, and animal manures.

6.6.1 Relationship between supplementary feed and fish production in different culture systems

In the natural environment when the growing in fish number and natural fish food organism are in equilibrium, it is need not necessary to provide supple-
mentary feed. When the culture system is intended to go in for more fish production, fertilizers and supplementary feeds should be supplied. In the extensive culture system the fish production can be enhanced by adding little amount of organic and inorganic fertilizers, whereas in semi-intensive culture system the fish production can be enhanced by adding the fertilizers along with sufficient amount of supplementary feed. Intensive culture system the fish production can be enhanced more by using large amount of supplementary feeds.

The fish can be enhanced by increasing the supplementary feed from the extensive to intensive practices.

6.6.2 Formulated feed

Rearing of spawn, fry and fingerlings until they become stock able size and their subsequent culture in grow out ponds require appropriate and nutritionally balanced diet for enhancing production. This is been of the essential requisites in the development of aquaculture. The advantages of formulated feed are

1. Proper formulated feed are in replica of exact nutritional requirement of fish. Therefore by understanding the nutritionally well balanced feeds which could be formulated using low cost feed stuff available locally.

2. Ingredients of formulated feeds can complement one another and arise the food utilization rate.

3. Proteins can supplement one another so as to satisfactory improve most of the essential amino acids content of the feed, thereby raising the protein utilization.

4. Large quantities of feeds can be prepared at a time good shelf-life so to be convenient to preserve, which can be used at the time of supplementary feeding.

5. Feed ingredient sources can be broadened with preferred and less preferred ingredients with additives like antibiotics and drugs to control fish disease.

6. High efficiency of feed can be achieved by judicious manipulation of feed ingredients and can be made commercially feasible.

7. By adding a binding agent to produce feeds, the leaching of nutrients in water is diminished and wastage is reduced.

8. Dispersing over large farm area is quite possible as formulated feeds
are convenient transport. These are suitable for automatic feeding, for which automatic feed dispensing devices could be successfully employed.

(a) **Suspended** : It is required feed, prepared with Acetes, Squilla and clams. Its preparation is discussed in chapter VG.

(b) **Pelletised feed** : This is a nutritionally well balanced solid feed and can be used off the shelf as and when required. This type of feed contains only ingredients of precisely known as composition and for this reason such diets are very expensive.

### 6.7 Signification of plankton and their culture

#### 6.7.1 Culture of phytoplankton

The unialgae are obtained by the isolation technique and transferred in culture tubes containing suitable sterilized medium and then placed in an inoculation chamber under required light and temperature condition, and pH and salinity is maintained accordingly. Stock cultures can also be maintained in 200ml conical flasks. These freshly 4 days, the growing cultures are poured into 1 litre conical flasks. These freshly inoculated flasks are placed in the same culture conditions. After one week sufficient concentration of growing cells can be achieved, Diatoms, Chlorella and flagellates are cultured in this way.

#### 6.7.2 Culture of Zooplankton

Culture of zooplankton such as copepods, rotifers, cladocerans larval stages of molluscs and small larval are suitable for feeding prawn larvae and fish. As the zooplankton feed on phytoplankton they are either cultured along with phytoplankton.

**Brachionus culture**

The rotifer Brachionus plicatilis is cultured in a 2000 m concrete tank. Stock is maintained in 1 m fiberglass tank. The rotifers with a water slurry of Baker yeast and Chlorella. The culture tanks are stirred each morning after feeding but are not aerated which allows the tanks to becomes anaerobic. It has been found that anaerobic conditions are essential for rapid proliferation to rotifers. Population densities of 500 to 700 rotifers/ml are reached within 15-20 days. Rotifer culture apparently can be harvested daily for a period of 45 days. It is harvested by drawing the culture through the a nylon net.

**Moina culture**

Miona culture in a 12 plastic pool by manuring with organic fertilizers in
the form of liquid manures. To start with, the plastic pool of 12 which has a capacity of 9,00 liters is manured with 18 liters of liquid manure and each subsequently day till Moina are harvested. Manuring is done with half the original dose. In the culture system, Moina is inoculated at the are of 50 individuals per litre of water and on the fifth day, a carp of Moina with a count of 20,000-25,000 individuals per litre (Tiwari 1986) can be harvested. Harvesting of Moina is usually carried out a night when all the plankton can be easily scooped up with a plankton net.

**Artemia**

Artemia commonly known as fairy or brine shrimp or sea monkey is a crustacean belonging to the group branchiopoda. It inhabits highly saline water and is found in natural and man made saline pens, lakes and flats from the temperature to sub-arctic regions. Under favorable conditions with respect to temperature and salinity, the brine shrimp bear its young alive in he form of nauplii. Any change is salinity leads to encystment which remains viable for many years. Such resistant are transported by wind and birds and under favorable conditions hatch within 24 hours as nauplii.

Generally Artemia is harvested from its natural habitats or is cultured under controlled conditions. The nauplii have 55.6% protein, 15.25% fat and 15.25% ash and meet all requirement of a nutritive live food. Artemia is omnivorous and a non selective feeder and feeds on protozoa, micro-algae bacteria and detritus.

**Artemia Culture**

Artemia cysts can be hatched out naturally by placing them in conical plexiglass hatching jar with natural sea water for 20-24 hours with continuous aeration. However at 5 ppt increase the salinity, the hatching rate increase and higher hatching efficiency is noticed. After incubation aeration is renewed for 10-15 minutes to allow egg capsules to float. The upper half of the conical tank is covered with black cloth so as to concrete the nauplii at the bottom which can be drained out into a strainer or a basin. The nauplii are rinsed with seawater remove remaining empty capsules and are fed to the prawn larvae at the required numbers.

**6.7.3 Culture of Lablab**

Lablab is the most natural food for brackish water prawn and fish. It is a biological mixture of phyto- and zooplankton forming food the bottom feeders. It consist of myxophyceae, bacillariophyceae and bacteria among phytoplankton and protozoans among zooplankton. Oligochaete worms are also
found in lablab. Generally myxophyceae member dominate the composition of lablab. When myxophyceae dominates in lablab, it is called as “Tai air” in Indonesia. When lablab is dominated by cholophyceae it is called as “Lumut” in Philippines.

Lablab can be cultured in brackish water pond., the pond is dewatered and the pond bed exposed to sun. Pond bed in dried until the bottom soil is fully dried, cracks and crumbles are formed. The pond is then filled up to 10-15 cm with sea water. Generally sea water is rich in nutrients, even though it better to fertilizers the pond to get thicker lablab. The pond fertilized either with cow dung or chicken dung at the rate of 500kg/ha. It is also manured with rice bran or oil cake at rate of 300-500kg ha. The pond is then allowed to dry up completely for 1-2 months. After drying a green mat is formed on the pond bed. This called labla. If the thickness of lablab is 1-3 mm it is sufficient for prawn and fish. If it less than the above thickness, the above process is repeated once gain to get the desirable thickness of lablab. After the desirable thickness of lablab is obtained the pond is filled with water and the prawn and fish are stocked.

6.8 Bio-enriched Feeds

Bioenrichment is the process involved in improving the nutritional status of live feed organism either by feeding or incorporating with in them various kinds of material such as micro diets, microencapsulated diets, genetically engineered baker’s yeast and emulsified lipids rich in w3HUFA (Highly Unsaturated Fatty Acid) together with fay soluble vitamins.

6.8.1 Factor to be considered prior to bioenrichment

(a) Selection of the carrier of biofeed: This is very important aspect taking into account the acceptability of the organism and its size. Commonly used carriers and their sizes ranges are listed as under

1. Microalgae : 2-20 U
2. Rotifers : 50-20 U
3. Artemia : 200-400 U
4. Moina : 400-1000U
5. Daphnia : 200-400U

(b) Nutritional quality digestibility and acceptability before and after enrichment. This requires extensive studies on all commercial species. The study will form a base line to conclude upon whether to go in for bioenrichment or not.
(b) Fixing up the level of the enriching media to be incorporated into the carrier organism. This depends on the nutritional quality of the carrier before incorporation and also based on the feeding trials conducted in the laboratory.

(c) Fixing up the level of the enriching media to be incorporated into the carrier organism. This depends on the nutritional quality of the carrier before incorporation and is also based on the feeding trials conducted in the laboratory.

(d) Economic feasibility of enrichment

(e) Purity of the culture of the carrier organism

(f) The other criteria that the carrier should satisfy include,

(i) It should be easily procurable

(ii) Culture should be economically viable

(iii) Catchability of the varier by the target species.

6.9 Feed Attractants

Freed attractants used in fish, shrimp, crab and eel culture systems. These are supplied in the form of pellets. Free amino acids and possibly small peptides serve as attractants for aquatic animals. These produce naturally occur in fish-shrimp head, crab, squid and clam meal. They also are highly concentrated in the dried solubilized or hydrolyzed marine animals products, such as the fish solubles, squid and shrimp solubles and fish silage. Marine animals solubles are the most common attractants used generally at levels of 1-5%. Mixture of synthetic amino acids may be used if cost effective. Generally two types of feed attractants are used the feeding stuffs as attractants and chemoattractants.

The feeding stuffs as attractants are fish meal, shrimp head meal or waste, shrimp meal, squid meal, crab meal or crayfish meal, other marine meals as a whole well dried powder.

Chemoattractants are betaines alanine, inositol brewing solubles, glutamates cholesterol, glycine lecithins.

Short Answer Type Question

1. Write the types of fishes based on the nature of food.

2. Define plankton.

3. Give any two examples of phytoplankton.

4. What are Zooplankton? Give an example.
5. What are ‘Rotifers’? Write any two examples.
6. What are protozoans? Give any two examples.
7. Name any two types of crustacean plankton.
8. Write the important nutritional requirements food.
10. What is artemia? Write its use.
11. Write is main types of formulated feed.
12. Write the any two examples of Chemoattractans.
13. What are Bioenriched feeds?

**Long Answer Type Question**

1. Explain the food any feeding habits of fishes.
2. Describe the food and feeding habits of shrimp larvae.
3. Write an essay on natural food organism.
4. Describe the supplementary feeds and their application.
5. Explain the any two types of plankton cultures.
6. Write short note on
   (a) Bio enriched feed
   (b) Feed attractants.

**O.J.T**

1. Student should visit local ponds, to observe and identify the natural food organism.
2. Visit to feed manufacturing centres.
UNIT 7

Health Management

Structure
7.1 Introduction
7.2 Classification of fish diseases
7.3 Common fish diseases
7.4 Common Shrimp diseases
7.5 Diagnostic methods
7.6 Therapeutic methods
7.7 Good Health Management

Learning Objectives
After completion of this unit the student will able to

• Understand the classification of disease
• Learn the common disease of fish and prawn and their control measures
• Understand the methods of disease diagnosis
• Know the importance of health management aquatic organism like fish and prawn.
7.1 Introduction

Fish are prone to hundreds of parasitic and non-parasitic diseases especially and grown under controlled conditions. Adverse hydrological conditions often precede parasitic attacks, as the resistance of fish is thereby lowered. Mechanical injuries sustained by a fish when handled carefully during fishing and transport may also facilitate parasitic infection.

7.2 Classification of Fish Diseases

The disease of fishes are classified as parasitic disease and non-parasitic disease.

Parasitic disease in fishes

Parasitic disease are also called as pathogenic disease or infectious disease of communicable disease. The important parasitic disease are viral, bacterial, fungal, protozoan, helminthic, annelid and crustacean.

The parasitic are mainly two types

1. These are found on the body surface, fins and gills.
   Ex: Argulus, Lernaea, Ergasilus, Leaches

2. Endoparasites: These are found inside the body. These are further divided into 3 types
   (a) Cytozoic parasites: These are found in the cells.
      Ex: Microsporadidia, Glugia
   (b) Histozoic parasites: These are found in the tissues
   (c) Coenozoic parasites: These are found in the body cavity or inside the alimentary canal.
      Ex: Diphyllobothrium, nematodes

Non parasitic disease

These disease also occur in fishes mainly due to environmental and nutritional problems. These are further divided into environmental fish disease and nutritional fish disease.

7.3 Common Fish Disease

1. Viral disease in fishes: Viruses are transmitted from one host to the other through a structure called virion. Viruses are classified mainly based on external structure, shape, size, capsid structure, RNA and DNA nucleic acids.
Viruses cause disease by weakening the host tissue or by forming tumors in the host tissues. There is no treatment for viral disease, which can only be controlled.

2. **Lymphocystis**: Woodcock (1904) identified this disease in fishes. Marine fresh water and aquarium fishes are susceptible to this disease. Tumor formation is the important character of this viral disease. The external lesions are raised, and made up of the growing of granular, nodular tissue which is composed of many greatly enlarged host cells. Matured lesions may be become slightly hemorrhagic. Within 6-15 days of infection the tumors grow to 50 thousands times. It caused a lot of damage in the Baltic sea area in America.

3. **Viral Hemorrhagic Septicemia (VHS)**: This disease is caused by an unequal shaped fish virus with RNA. This disease occur in salmon fishes. Transmission of the disease occur through the water by a flagellate. This disease is also called as infections kidney swelling and liver degeneration in German and pernicious anaemia. Infectious anaemia or entero-hepatic renal syndrome in France. The symptoms are Kidney swelling, reduced appetite, obvious distress, erratic spiral swimming, multiple hemorrhages in skeletal muscles, change in body colour reddish fins. The only present measure in prevention.

4. **Infections pancreatic Necrosis (IPN)**: This disease is found in trouts. This disease causing high mortality of fry, fingerlings and occasionally larger fish. The symptoms are darkening distension and a time, hemorrhages in ventral areas including bases of fins. There is pronounced pancreatic necrosis. 200 ppm of chlorine is effective for treatment.

5. **Infective Hemopoietic Necrosis (IHN)**: IHN was observed for the first time in trouts in British Columbia (Canada) in 1967. Necrosis is observed in the hemopoietic tissue of kidney in infected fish. This disease occur more in fry and fingerlings and occasionally in adults. The symptoms are pale gills, reddish fins, black colouration of the body, abdomen swelling, and huge mortality. The symptoms and clear in 12-45 days after the entry of virus into the host body.

6. **Chinook disease**: A small size virus is responsible for this disease in Chinook salmon (Oncorhynchus tshawytscha) fingerlings. The symptoms are exophthalmus distended abdomen a dull red area on the dorsal surface anterior to dorsal fin. The liver, spleen kidney, gills and heart are pale. The disease is transmitted by the egg form the carrier female. No treatment.

7. **Channel cat fish virus disease**: This disease occur in fingerlings of cat fish (Lactatularus Punctatus). The symptoms are the fish show abnormal swimming and rotating, hemorrhagic areas on fins and abdomen. Fluid accu-
mulation in abdomen and pale gills. There is no treatment for this disease. De-
struction of infected fish may prevent spread of the disease.

8. **Bacterial disease in fishes**: Bacteria are responsible for many fatal disease in fishes like, furunculosis, columnaris, fin or tail rot. Vibriosis, dropsy, cotton mouth disease and tuberculosis.

9. **Furuculosis**: Furuculosis disease is caused by Aeromonas salmonicida in salmon fishes. It is a non-motile, gram-negative bacterium. This disease frequently appears to infect fishes living in the dirty waters containing a large amounts of decaying matter. This disease is also observed in few other fishes. The first symptoms of this disease is appearance of boil-like lesions. Other symptoms are blood-shot fins, blood discharge from the vent hemorrhages in muscles and other tissues and necrosis of the kidney.

Sulfonamides like sulfadiazine or sulfaguanidine are given orally with food at the rate of 22 gms/100kg. of fish/day other. Other antibiotics like chloromycetin and tetramycin are most effective at a dose of 2-7.5 gm/100 kg of fish/day. Disinfect the egg with 0.015% solution of merthiolate or 0.185% acriflavine.

10. **Columnaris disease**: Columnaris disease is caused by Chondroccus columnaris and cytophaga columnaris in fresh water aquarium fish. It is long thin, flexible gram negative slime bacterium (myxobacteriales). This disease is often associated with low oxygen level. Initially it is marked by appearance of greyish white or yellowish white patches on the body. The skin lesion change to ulceration and fins may becomes frayed. Gill filaments are destroyed and eventually lead to the death of fish. Addition of 1 ppm copper sulphate in the pond to control this disease is effective Tetramycin administered orally with food at a rate of 3gm/100 pounds of fish/day for 10 days is very effective. Dip treatment in malachite green (1:15000) for 10-30 seconds and one hour bath in 1 ppm furanase is very effective to control this disease.

11. **Fin or tail rot**: Tail or fin rot disease is caused by Aeromonas salmonicid and. A liquefacient. However protozoans and fungi may also be involved. It is progress towards the base of white lines along the margins of fins, the opacity usually brittle towards the base eroding them, and causing hemorrhage. The fin rays become may also spread on the body surface. Fin and tail rot are associated with poor sanitary conditions in fish ponds and with water pollution in nature.

The fin or tail may be checked art an early stage by keeping fishes in
0.5% copper sulphate solution for 2 minutes. Control may be achieved with 10-50 pp, tetramycin and 1-2 ppm of benzalkonium chloride.

12. Vibriosis: Vibrio bacteria are the causative agents of vibriosis disease in salmon and many other fishes. This disease may occur in water with low oxygen. These bacteria are small gram-negative bacilli characteristically curved. Diseases fishes show large, bright coloured bloody lesion in the skin and muscles, hemorrhage in eyes, gill may be bleed with slight pressure and inflammation of the intestinal tract. Sulfamethazine at a rate of 2gm/100 pounds if fish/day gives good results 3-4 gm 100 pounds of fish/day for 10 days tetramycin also gives satisfactory results.

13. Dropsy: Pseudomonas punctata is the causative agent of the disease. It is characterized accumulation of yellow coloured fluid inside the body cavity, protruding scales and pronounced exophthalmic conditions. This is known as intestinal dropsy. In case of ulcerative dropsy, ulcers appears on the skin, deformation of back bone takes place and show abnormal jumping. This is fatal disease in culture systems.

Removal and destruction of fishes, followed by draining, drying and disinfecting the pond with lime are preventive measures to control the disease. The infected fishes may be cured with 5 ppm potassium permanganate for 2 minutes dip bath. Streptomycin and oxyetracyclin give good result.

14. Cotton mouth disease: The filamentous bacteria, fexibacteria is the causative agent of this disease. The main symptom is appearance of fungus like tuft around the mouth. This can be treated with antibiotics like 10 ppm chloramphenicol for 2-5 days and 0.3 ppm furnace for long term bath.

15. Tuberculosis: Mycobacterium is a disease causing agent which is difficult to diagnose without pathological examinations. The symptoms are ulcers on body. Modules in internal organs fin or tail or, loss of appetite and loss of weight of fish. This can be cured with dip treatment in 1:2000 copper sulphate for 1 minute for 3-4 days. Antibiotics are not successful. The fishes should be destroyed and potassium permanganate or lime used in the pond.

16. Bacterial gill disease: This disease is caused by Mycobacteria in salmon fish. Many bacteria are found in swollen gill lamellae which slow proliferation of the epithelium and symptoms are lack of appetite. This disease is transmitted through water from infected fish. It can be treated with 1-2 ppm timsan or 1 ppm copper sulphate.
7. 3.1 Fungal disease

**Saprologniasis:** This is also called as cotton wool or water mould disease. This disease is caused by *Saprolegnia parasitica*. It is the most common fungus affecting fishes especially major carps. The fry and fingerlings when transported over long distances to get bruises on the body, and unless properly disinfected, becomes sites of infection resulting in large scale mortality. Whenever fish get injuries the fish becomes weak and lethargic, and gradually die after ulceration, and exfoliation of the skin followed by hemorrhage exposure of jaw.
bodies blindness and inflammation of liver and intestine. This can be treated with 1-3 ppm malachite green for one hour or 1:500 formalin for 15 minutes.

7.3.2 Brachiomycoses

This is B. Sanguinis. It is required to be common on cultivated fishes in ponds having abundant decaying organic matter. The tubules of fungus for into the respiratory epithelium of the gills, causing inflammation and damage of their blood vessels. The blood supply is stopped to the infected area as a result of which it becomes necrotic. It can be controlled with 5% common salt for 5-10 minutes.

7.3.3 Ichthyophonosis

It is also known as reeling disease. It is characterized by swinging movement of the infected fish. It is caused by Ichthyophonus hoferi. It enter into the host along with the food. The spores spread to the various organs and in severe cases spread out to the skin which may rupture and becomes ulcerative at several places. It is extremely difficult to control this disease. The infected fishes are isolated form the stock and kept for treatment in separate ponds. Medicines like sulfamethanis, terramycin, erythromycin and calomel are useful to treat the infected fish.

7.3.4 Protozoan disease

Whirling disease

This disease is caused by a myxosporidian protozoan, Myxosoma cerebralis only in salmon fishes. The symptoms are pancreatic necrosis lesions and disintegration of the cartilaginous skeletal support of organ of equilibrium. If the pond contains all infected fish, it is better to destroy them by deep burial. Then the pond should be cleaned thoroughly and disinfected with calcium cyanamide, quick lime or sodium hypochlorite.

Costiasis

This is caused by a Mastigophore costia necatrix in culture fishes. This is common disease in ponds where fishes live densely in water with a low pH and poor condition of food. The parasites live in large numbers on fish skin, fins and gills. The symptoms turns to red patches in severely affected cases. The infected fish become weak, loss of appetite occur and they finally die. They can be treated with 3% common salt for 10 minutes or 1:2500 formalin solution.
Fig 7.2 Common fish parasites

- Ichthyophthirius
- Saprolegnia
- Costia
- Trichodine
- Diplostomum
- Dactylogus
- Ligula
- Hemiclepsis
- Argulus
- Ergasilus
(a) Achlya
(b) Aphanomyces
(c) Saproleginia
(d) Dactylogyrus
(e) Costia
(f) Trichodine
(g) Diplostomum
(h) Dactylogyrus
(i) Ligula
(j) Philometra
(k) Camallanus
(l) Hemiclespsis
(m) Clavellisa
(n) Lerhaea
(o) Caligus
(p) Ergasilus
(q) Larnaenicus
(r) Caligus
(s) Pseudocyonus

7.3.5 Ichthyophthiriasis

This disease is caused by ciliate, Ichthyophthirius multifilis. This disease is also called as ich or white spot disease. Infected fish develop small white spots on the skin and the fins. These parasites attack the gill also. Fish respond by jumping in the water and rubbing their body against the water objects. Respiration gets effected and they finally die. Dip treatment in 1.5 ppm of malachite green or in 10 ppm of acriflavine gives good results. 3% salt solution, 1:4000 formalin, 1:1000000 quinine hydrochloride, 1:5000000 methyl blue are also useful to treat the fish.

Coccidiasis

Coccidia or Eimeria carpella and E. epithilialis are cytozoic parasite in
the intestine of fresh water and brackish water fishes. It forms white tumors in fishes. Fish become weak and the infection caused by this parasite gives the opportunity to bacterial and fungal disease to manifest themselves. 100 mg. 1 kg of fish or furazolidin gives good results in the control of this disease.

7.3.6 Helminthic disease

Dactylogyrosis

The monogenic trematode, Dactygyrus is reported to cause serious infection in fishes. Infected fishes are rest near the surface of the pond margin swim very slowly, feel suffocation are more slimy, dropping chloride of fins and pale gills. Alternative baths with 1:2000 acetic acid and 2 % sodium chloride are effective. 10 ppm of potassium permanganate bath for 1-2 hour and 5 ppm the pond may give good results.

Gyrodactylosis

Another monotreme trematode, Gyrodactylus also cause disease in culture ponds. This is also lives on the fins and on the body of fish. The symptoms are production of more slime, damage of fins and fading of the body colour. The medicine used in control of dactlyogyrosis are also effective to control this disease.

Leeches disease

Leeches like Piscicola, Myzobdella and Hemiclepsis hold the skin of the fish and such fish blood. After the blood meal they detach themselves, leaving the wound open for secondary fungal infections. The growth of fish is affected and they become weak. A popular control method is dip treatment in 2.5% sodium chloride for 30 minutes. Disinfect the pond with lime of destroy the eggs and adult leeches.

7.3.7 Crustacean disease

Argulosis

Argulus or fish lice is a common copepod parasite in fishes. It is large ectoparasite and can move over the body surface of the fish. Argulus picture the skin and inject cytolytic toxin through the oral sting to feed on the blood. The feeding site becomes a wound and hemorrhage, providing ready access to secondary infection of other parasites, bacteria, virus and fungi. Argulus transmits dropsy in fishes. In advanced stages fish swim erratically show growth loss and loss of equilibrium.

To control Argulus, remove the submerged vegetation, wooden lattices
placed in the pond will serve as artificial substrate to deposit its eggs. Which can be removed in intervals to kill the eggs. 500 ppm of ammonium chloride, 410 of balsam, 10 ppm of DDT for 25 seconds dip 0.25 ppm id dylox and 2000 ppm of lysol for 15 second dip are effective to kill Argulus.

7.3.8 Lernaeasis

It is caused by a copepod parasite, Lernaea or anchor worm. This disease is mostly caused by L. Cyprinacea. The larval stages are temporary parasites that feed on mucous and blood fish. The adult female is special fish parasite work like which burrows into the fish. Keeping its egg cases protruding out of the fish body. Male Lernae do not attach the fish and are unspecialized for parasitic life. Early infected fish swim erratically flashing against the sides and bottom of ponds. Heavy infected fish swim inside down or hand vertically in the water.

Only partial control of Lernae is possible with chemical because the head i buried in the fish tissues and there are no exposed respiratory organs. Hence prevention is more effective than control. 1% common salt eliminates larvae in 3 days, 250 ppm formalin for 30 to 360 minutes 0.2 ppm gammexane for 72 hours , 2ppm of lexone 0.1 ppm lindane for 72 hours and 1pm chlorine for 3 days any give good results.

Ergasillus and salmincola

These two parasites are responsible for huge mortality of fishes in the culture systems. These two parasites are found attached to the gill filaments and feed on blood and epithelium. Later they may also be found on the fins and body. The infection results in impaired respiration, epithelial hyperatrophy, anaemia, retarded restlessness and finally death.

Ergasilus can be treated successfully with a combination of 0.5 ppm copper sulphate and 0.2 ppm ferric sulphate for 6 to 9 days. Salmonicola can be controlled with 0.85 calcium chloride, 0.2 % sulphate , 1.7% magnesium sulphate , 0.2% potassium chloride ad 1.2% sodium chloride for 3-4 days.

Algal disease

Cyanophyceae member, Oscillatoria si responsible for fish mortality it si found on gill and fish body in large numbers and produce toxic substances which are responsible for fish kill. Chlorella and Pharmidium also cause discomfort in fishes.

Epizoic Ulcerative Syndrome (EUS)

Epizoic ulcerative syndrome popularly known as EUS has caused serve
damage to India’s aquaculture especially at the moment when the Indian fisheries industry is poised for a great leap forward with high input based hitech production systems. Widespread outbreaks of the disease, occur suddenly and often cause mass mortality in freshwater and brackish water fishes causing anxiety and tremendous concern. Although the disease has been known in the Asia-Pacific region since the seventies, it appeared for the first time in India in 1988 and has now covered almost the entire length and breadth of the country.

One common feature of the disease is that initially affects the bottom-dwelling species like murrels, followed by catfishes and weed fishes. Subsequently the Indian.

Clinical signs and gross pathology in the affected fishes are similar in almost all the species with moderate to severe ulcerative skin lesions. The lesion starts as small gain to pea-size hemorrhagic spots over the body which ultimately turn into big ulcers to the size of coin with greyish, slimy central necrotic area surrounded by a zone of hyperemia. The disease affects the fish to such an extent than they start rotating while still alive and eventually die.

The mixture has been named Cifax. The yellowish brown liquid is advised to be diluted in a sufficient quantity of water before being sprayed over the water body evenly for a throughout mixing. Appreciable changes are noticed in the affected fish with in 3-4 days and marked improvements of the ulcerative condition is noticed within 7 days.

Health Management: The principle of fish health management incorporates minimizing stress in cultivated fishes, confinement of disease outbreak to affected ponds and minimizing losses from disease outbreak. This could be achieved thought prophylaxis and positive treatment to the outbreak of epidemics. Because of the aquatic ambience, it is not easy to be aware of the activities of fish. It is difficult to conduct a correct diagnosis and timely treatment. This necessitates prevention of fish disease which is more important control of fish disease. The signifies the importance of the statement “prevention of better than cure”

Prevention of fish disease

(a) Importance: It is difficult the appearance of disease in its initial stage on account of the gregarious nature of fish in water which causes difficulties in observation diagnosis and timely treatment. Apart form his, some effective drugs and measures to cure certain fish disease are skill not known well. Therefore, perfect prevention measures must be taken since this is a key link fish disease control.
(b) General preventive measures: Increasing the internal resistance of fish is important in the prevention of diseases. Therefore, some important in fish culture should be given special attention.

1. Selection of healthy fish seed.
2. Proper density and rational culture.
3. Careful management
4. Qualitatively uniform ration and fresh food.
5. Good water quality
6. Prevention of fish body from injury.

7.4 Common Shrimp Diseases

Viral disease

The viral infections of prawns heavy losses in culture ponds. There are more than a dozen prawn virus, out of which half a dozen of them cause major economical losses. Prawn viruses are broadly classified into two types

1. Virus with endoderm derived tissues

   Ex: Hepatopancreatic parvo like virus (HPV), Monodon type of Bacilovirus (MBV) and type c baculovirus, Baciilovirus penai (BP) and Baculovirus midgnt glad necrosis virus (BMNV).

2. Viruses systemic endoderm or mesoderm derived tissue tropism.

   Ex: Infections hypodermal and haematopoitic necrosis virus (IHHNV), Yellow head virus (YHV) and systemic ectodermal and mesodermal baculovirus (SEMBV).

Yellow head virus (YHV or YHD) Disease

It is commonly known as yellow head disease or yellow baculovirus. YHV mostly affect shrimp juveniles of all ages. Head looks yellowish or organ yellowish in colour. Feed intake is almost nil prior to the serious disease out break. Shrimp become inactive and move slowly at the inner edges of the pond bund. Mass mortality occur with in 3-5 days of the first clinical signs.

Systemic Ectodermal and Mesodermal Baculovirus Disease (SEMBV)

The SEMBV cause infection in all penaeid species. It is able to cause acute epizootics of 2-7 days duration with mortalities from 10-70% up to 100% and massive systemic pathology. The clinical history and signs, histopathology
rein infection studies transmission electron microscopy (TEM) and DNA probe in growing pond reared panaeid species is revealed that the acute mass mortalities are due to SMBV. The SEMBV is commonly known as ‘white spot or white patch’ disease. The clinical sign of SEMBV include white spots at an early stage on the carapace later on the posterior abdomen and the body; lethargic movements reduced feed in take gill and antennule rot, gills become yellowish or rarely in colour. In some of the cases mortality occurred with out clinical signs of SMBV and almost look normal.

**Prevention and control**

There is no known control therapy for viral disease in the shrimp. No medicines, chemicals can disinfectants are effective against viral disease.

**Preventive measures**

1. Dry the pond soil at least for 15 days.
2. Disinfect the soil water by administering bleaching powder (calcium hypochlorite) at required (10-30 ppm) dosage.
3. Adapt the closed and recycle system of water.
4. Minimize the water exchange.
5. Select and stock healthy post larvae.
6. Avoid high stocking density
7. Maintain the optimum water parameters to minimize the stress on shrimp.
8. Avoid feeding prefer nutritionally balanced pelleted feed.
9. Prevent the entry of crabs, birds and other vectors.
10. Destroy the viral infected shrimp by burning.

**Bacterial disease**

The important bacterial disease of prawns are Vibriosis, Shell disease (Black spot disease), Tail rot disease and Filamentous bacterial disease.

**Vibriosis**

The Vibriosis in shrimp is known to be the major bacterial disease. It is almost found in all the shrimp culture ponds at same time or the other. The infected shrimp revealed the occurrence of various species of Vibrio. The clinical sign of vibriosis in shrimp include the infected part becoming red in colour,
sluggish movements the nerve chord become red in colour, lack of appetite leading to reduced feed in take the digestive tube is found empty, mortality starts with in 2-3 days of infection and large number of shrimps die at once.

The vibrio sp, infect at all stages ages and sizes of shrimp. The Vibrio infection in larvae is known as larval septicaemia. The infected are inactive reluctant to feeds and light. In some of the cases infection of vibrio and SEMBV were found.

Shell Disease

It is also known as black spot disease due to the presence of black spot/specks on the shell. The black spots are caused by the Aeromonas sp Flavobacterium sp, Spirellum sp, and Staphylococi bacteria. The black spots on the shell of shrimp occur in many other cases also. Confirmation of the causative agents depends on the bacterial culture test.

Tail Rot

The uropods and telson possesses cuts on their edges. The tail look ugly. The diseased Shrimps move in zigzag manner, The feed intake is normally good. The antennules and the squama are also rotten or swollen in shape. The tail rot disease is caused by the detritus bacteria and Flavobacterium species.

Filamentous Bacterial Disease

The filamentous bacteria, Leucothrix, sp infect gills, and appendages around the mouth. The respiration become difficult. The infected shrimps are move in surface waters, the feed intake may be reduced. The movements may be sluggish. In case of severe infection on the entire body the shrimp possess a fuzzy mat and looks ugly.

Prevention and control

The pond soil should be thoroughly before chemical fertilizers are applied to the pond. There should be reservoirs tank for every shrimp. The water in the reservoir tank should be disinfected by administering chlorination/formalin treatment. The settled hygienic, clear surface and middle waters of the reservoirs tank only should be pumped into the culture ponds.

The feeds should be nutrients less in moisture free from all contaminations. The rate of feeding should be as per the size age of the shrimp and their total body weight. Excess feed administration should always be avoided as it leads to organic load in the soil and pond water.

The bacterial disease of shrimp are being controlled by treating with
benzylkonium chloride at 0.5 to 1.0ppm, formalin at 20 ppm or iodine at 0.2 to 1.0 ppm to the pond waters and administering oxytetracycline at 3 to 5 gm/kg, nitrofurans 1.5 to 2.5 gm/kg or chloramphenical at 1.5 to 2.5 gm/kg of feed and fed for to 7 days.

**Fungal disease**

The fungi Leginidium sp. And Fusarium sp., cause severe infections on larvae and shrimp in culture ponds.

**Legenidium**

The legenidium so is mainly found in larval mycosis. The larvae is hatcheries can also be affected by the fungi Syroplidium. Helipthorus and Atkensilla sp. The fungi spread on the whole body of the larvae. The infected larva become yellowish green in colour inactive reluctant to feed and light. The fungi spreads to almost all the larvae in the tank, leading to more larval deaths. The clinical sign of shrimp infected by Leginidium are the gills becomes black in colour, and the larvae of shrimp lethargic movements 1-2 infected shrimps die/day during the early days infection. If no control measures are taken, large scale mortality may result.

**Fusarium**

The clinical signs of Fusarium sp infected shrimps are presence of fuzzymat on the body which is white of light yellow in colour and lethargic movements. The infected shrimp swim in surface waters, and may lie down on the grass or on any substance at the inner edges of the pond bund. The mortality rate may start with in 3-5 days after infection at the rate of 1-2 shrimp which gradually increases to 5-10 shrimp/days.

**Control** : The fungal infections of shrimp can be confirmed by observing the sample of the infected part on slide under a compound microscope. The fungal infections of shrimp are being controlled by administering malachitegreen at 0.01 ppm of formalin at 10-20 pp, to the pond waters.

**Protozoan disease**

The protozoan, Zoothammium, Epistyllis, Vorticella, Acinata, Thelohania, Pleisthophora, Nosima, Laginofress, sp cause disease in shrimps. The protozoans grow over the shrimp body. They may be present on the eyes, antenna, appendages, gills and in server conditions may spread all over the body. Some of the protozoans penetrate deep into the body and cause injuries. This facilitates infection by bacteria, virus a and fungi. The protozoans cause tress and irritation to the shrimp. The protozoans on the gills cause difficulty in respiration. The prolific and colonial growth as cotton shrimp disease. The protozoans on
the shrimp body look like cotton and because of this. It is also known as cotton shrimp disease. The movements with reduced feed intake resulting in decreased growth rates. The severity of protozoans can be reduced by treating the pond waters with formalin at 20-25 ppm or Chloramine Tar 0.3 to 0.5ppm or Glutaraldehyde at 0.2 to 0.5 ppm dosage.

**Nutritional disease**

The nutritional disease are caused due to deficiency of the nutrients proteins, carbohydrates, fats, vitamins, and minerals. The important nutritional disease of shrimps are scurvy (black death disease), blue shrimp disease and soft / loose shell disease.

**7.4.5.1 Black death disease or scurvy**

Shrimps like many other animals cannot synthesize ascorbic acid and its non inclusion in shrimp feed lead to deficiency this resulting in reduced growth, poor feed conversion efficiency poor injury and wound repair, incomplete moulting and presence of white / black lesion beneath the exoskeleton. The ascorbic acid deficiency for a continuous period result in the death fo shrimp. The mortality rate can be prevented with in 5-7 days by administering ascorbic acid at 2-5 mg/kg in feeds.

**Blue shrimp disease**

The minerals and astaxanthene (pigmented substance) deficiency in supplementary feed in result in to blue shrimp disease. The shells become soft l thin and blue in colour. The supplementation of mineral and astaxanthene through feeds improve that natural colour of the shrimp.

**Soft Shell Disease**

The deficiency of calcium and phosphorous in shrimp nutrition result in the soft shell disease. The shell become soft the shrimp look weak and growth is stunted.

**Environmental disease**

The change in environmental parameters of shrimp results in stress, weakness, poor growth rates are reduced feed intake. The known environmental disease of shrimps are gas bubble disease, blister or dropsy, inflamed gills, red gill disease, black gills disease, acidosis/alkaosis, asphyxia and cramped body and tail.

**Gas Bubble Disease**

The supersaturation at atmospheric gases an oxygen in pond water
causes gas bubble disease. The respiration in juveniles and adult shrimps becomes difficult feed intake is reduced, less growth is found resulting in weakness and eventually may lead to death. If new waters are pumped in the supersaturation of gases decrease and restores normal health of the shrimp.

**Blisters or dropsy**

Sudden change of pond water by pumped waters causes blisters in the shrimp. The blister are mainly situated at the inner wall of the gill chamber. Respiration becomes difficult shrimp become sluggish and slowly swim at the inner edges of the pond waters. The uropods are swollen at their ends, which gradually become normal in a day or two. If the blister are swollen tails are ruptured and a thick liquid comes out.

**7.4.6.3 Inflamed gills**

The change of water in the pond cause turbidity due to highly dissolved clay particles any phyto and zooplankton which cause inflammation of gills. They heavy metal toxicity also cause inflammation in gills. Respiration become difficult to control measurers are reserted to an shrimps die in large numbers.

**Red/ Orange gill disease**

If a prolonged dissolved oxygen depletion prevails in pond water causes red/orange gill disease. The gills look orange red in colour. The growth is stunted, shrimps move in the surface waters and finally death occurs. Red gill disease is also caused due to excess of iron and pond soil and waters. Confirmation agents can only be made after analyzing the waters. Dissolved oxygen level in pond water can be increased by arranging aerators paddle wheeler etc.

**Black gill disease**

The black gill disease in shrimp is caused due to high organic content, debris ammonia and H2S in the pond soil waters. As such black gill disease is also caused due to vitamin C deficiency and bacterial fungal infections. By reducing the organic load. Ammonia and H2S the black gill disease in shrimp can be controlled.

**Acidosis / Alkalosis**

The acid or highly alkaline nature and soil causes acidosis / alkalosis respectively. Poor growth soft shell, incomplete moulting, decreased moulting frequency discolouration of shell are the clinical signs of acidosis/alkalosis. The acid and alkaline nature of pond water and soil can be corrected by adding required quantities of lime of gypsum respectively.
Cramped Tail

The shrimp right form its abdomen and tail are cramped, and if they are body and tried to be made normal they die. The reason for such nature of the shrimp is suspected to be sudden change in the environmental temperature.

7.5 Diagnostic methods

Fishes are poikilotherm hence the environmental impact is more than fishes when compared to warm-blooded animals. The following aspect are useful for the identification of diseased fishes.

1. Disease can be diagnosed only in freshly killed fishes are live fishes. If it is late after the death of fish, diagnoses is very difficult due to chemical changes in the body and normal temperatures.

2. Slime production is more in diseased fishes.

3. After death, the fish settle on the bottom of pond, then come to the water surface due to the gasses produced by chemical changes in the body.

4. Mucus samples should be collected from body surface and gill and examine them under the microscope.

5. Change body colouration.

6. Abnormal behavior of the fish.

7. Examine the size, colour and shape of the internal organs like liver, kidney and spleen.

8. Examine the fluid accumulation, hemorrhages and inflammation in the body cavity of fish.

9. Take out the samples from vital organs and go for bacteriology, virology and histological studies.

11. Examine for tumors or swelling in the body.

7.6 Therapeutic Methods

Chemoprophylaxis

Effective and inexpensive prophylactic measure against wide range of parasitic and microbial disease are advisable as chemoprophylaxis (Table 6.5). Occasional pond treatment with potassium permanganate at the rate of 2.3 ppm die treatments with potassium permanganate at the rate of 500-1000 ppm for
1-2 minutes or short bath in 2-3% common salt solution is safe. Some of chemoprophylaxis used in culture practices are given in table 6.5. Besides oral administration can be given for preventing systemic infections.

**Immunoprophylaxis**

Immunization programme is gradually emerging as one of the most important measures for preventing infectious disease. Vaccine to combat bacterial disease for carps are available in developed countries. Vaccine against Aeromonas hydrophila, Pseudomonas columnaris, Edwardsiella tarda, E. ictaluri pathogens.

**Chemotherapy**

The term chemotherapy was introduced by Paul Ehrlich (1854-1915) cites by Smith, 1979; who was pioneer in the development chemotherapeutic agents (Table 6.6). It is produce employed to restore normal health condition for fish. Therapy is applied in 3 ways external treatment systematic treatment through diet and parenteral treatment.

Antibacterial agents or antibiotic include sulfonamides nitrofurans, furanacea tetracycline 4 quinolones erythromycin, chloramphenicol which are being used to combat fish disease (Table 6.6). In 1941 the term antibiotic was defined by Waksman (1946) as a chemical substance produced microorganism which have the capacity to inhibit growth of bacteria and other microorganism in dilute solution.

<table>
<thead>
<tr>
<th>Disinfectants</th>
<th>Treatment</th>
<th>Cement</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Acriflavin</td>
<td>3-10 ppm for pond treatment. Bath in 500 ppm for 30 minutes.</td>
<td>Protozoan and egg disinfection pond disinfection.</td>
</tr>
<tr>
<td>3. CaCl₂</td>
<td>25-1800 mg/litre of water depending on situations.</td>
<td>Pond disinfectant.</td>
</tr>
<tr>
<td>4. Calcium oxide</td>
<td>46-60 ppm or 2000 kg/ha in drained wet ponds.</td>
<td>Pond disinfectant.</td>
</tr>
<tr>
<td>5. Malachite green</td>
<td>(i) Dip treatment in 66 ppm for 10-30 seconds (ii) 1-5 ppm bath for 1 hour.</td>
<td>Fungus prevention in eggs.</td>
</tr>
</tbody>
</table>
7.6.1 Non-parasitic disease

These disease also occur in fish, mainly due to environment and nutritional problems. These are further divided into environmental disease and nutritional fish disease.

Environmental disease

The environment which is the fish live and grow plays an important role in fish health. Any deterioration in the environmental qualities often creates stress...
to fish and favor multiplication of pathogens.

Stress response from the environment leads to fish mortality in extreme cases. The sub-lethal level. There may be several other response like changes in fish behavior reduced growth/food certain efficiency reduced reproductive potential reduced tolerance to disease, and reduced ability to tolerate further stress.

The environmental disease diagnosed are

(a) **Depletion of oxygen**: The mouth remains open. Gills look pale with wide opercle. Bigger fishes diet first.

(b) **Excess of carbondioxide**: Extensive secretion of mucus of high pH level in pond of epithelial cells.

(c) **Nitrogenous water and ammonia accumulation**: Gills look dark diet to formation of methemoglobin a combination of nitrogen had haemoglobin.

(d) **Supersaturation of oxygen of nitrogen**: Accumulation of gas bubbles with in the body cavity of fish spawn.

(e) **Excess of hydrogen sulphide gas**: Pond muck smell like rotten eggs. The bottom dwelling fish come up the surface and diet first.

(f) **Organic pollution**: Dropping of pectoral fins in case of organo-phosphorous pesticides. Oozing of blood from eyes in some dis ease.

(g) **Algal toxicosis**: Algal bloom may appear in ponds are due to accumulation of plenty of organic mater or due to excessive chemical fertilizers. Toxins released by blue green algae like Microsystis, Aanabaena and Aphanizomenon kill other phytoplankton and cause surfacing of fish stock

(h) **High temperature of water**: The fish on crossings tolerance limit shows the alarm syndrome initially i.e. coming up surface, splashing water and finally exhausted and sinking to the bottom. Indian minor carps die when the temperature is 39°c and air breathing cat fishes get exhausted at 42°c.

(i) **Europhication**: Water body looks pea-soup green in colour due to bloom of blue green algae.

**Acidosis and alkalosis**

A great majority of fish live in pH 7-8. However of the PH of water goes down drastically owing to reduction of calcium salts to release of humic acids from the soil, a phenomenon known as acidosis results when the fish may show over rapid swimming movements and attendance to jump out of water. In
the gills of carps, acidosis causes dark-greyish water deposit darkening to the edges and mucous secretion. In the event of mortalities in ponds due to acidosis, the pH must be normalized with powdered calcium carbonate and not with quicklime.

Aquatic plants present in high densities liberate enormous quantities of oxygen during photosynthesis which is responsible for the formation of insoluble calcium carbonate. Carbonate form calcium bicarbonate followed by formation of calcium oxide with the elimination of carbon dioxide. This phenomenon is known as alkalosis. Excessive alkaline condition leads to corrosion of bronchial and fins. Alkalosis can be prevented by buffering the medium by means of suitable calcification.

**Gas Bubble Disease**

When nitrogen of the water is higher than 125 percent saturation due to rapid temperature changes, gas bubble disease may result and fish fry particularly die in large number.

**Nutritional disease**

Nutritional fish disease can be attributed to deficiency excess of improper balance of components present in the food available. Symptoms appear gradually when one or more components in the diet from below the critical level of the body reserves.

## 7.7 Good Health Management

Fish health management is a term used in aquaculture to describe management practices which are designed to prevent fish disease. Once fish get sick it can be difficult to salvage them. Successful fish health management begins with prevention of disease rather than treatment. Prevention of fish disease is accomplished through good water quality management, nutrition, and sanitation. Without this foundation it is impossible to prevent outbreaks of opportunistic diseases. The fish is constantly bathed in potential pathogens, including bacteria, fungi, and parasites. Even use of sterilization technology (i.e., ultraviolet sterilizers, ozonation) does not eliminate all potential pathogens from the environment. Suboptimal water quality, poor nutrition, or immune system suppression generally associated with stressful conditions allow these potential pathogens to cause disease. Medications used to treat these diseases provide a means of buying time for fish and enabling them to overcome opportunistic infections, but are no substitute for proper animal husbandry. Daily observation of fish behavior and feeding activity allows early detection of problems when they do occur so that a diagnosis can be made before the majority of the population becomes sick.
treatment is indicated, it will be most successful if it is implemented early in the
course of the disease while the fish are still in good shape.

The Significance of Fish Disease to Aquaculture

Fish disease is a substantial source of monetary loss to aquaculturists. Production costs are increased by fish disease outbreaks because of the
investment lost in dead fish, cost of treatment, and decreased growth during convalescence. In nature we are less aware of fish disease problems because sick animals are quickly removed from the population by predators. In addition, fish are much less crowded in natural systems than in captivity. Parasites and bacteria may be of minimal significance under natural conditions, but can cause substantial problems when animals are crowded and stressed under culture conditions. Disease is rarely a simple association between a pathogen and a host fish. Usually other circumstances must be present for active disease to develop in a population. These circumstances are generally grouped under the umbrella term “Stress”. Stress is discussed in greater detail in the UF/IFAS Extension Circular 919 Stress - Its Role in Fish Disease. Management practices directed at limiting stress are likely to be most effective in preventing disease outbreaks.

Determining if your fish are sick: The most obvious sign of sick fish is the presence of dead or dying animals. However, the careful observer can usually tell that fish are sick before they start dying because sick fish often stop feeding and may appear lethargic. Healthy fish should eat aggressively if fed at regularly scheduled times. Pond fish should not be visible except at feeding time. Fish that are observed hanging listlessly in shallow water, gasping at the surface, or rubbing against objects indicate something may be wrong. These behavioral abnormalities indicate that the fish are not feeling well or that something is irritating them.

Fig 7.3 Disease rarely results from contact between the fish and a potential pathogen.
In addition to behavioral changes, there are physical signs that should alert producers to potential disease problems in their fish. These include the presence of sores (ulcers or hemorrhages), ragged fins, or abnormal body confirmation (i.e., a distended abdomen or “dropsy” and exophthalmia or “popeye”). When these abnormalities are observed, the fish should be evaluated for parasitic or bacterial infections.

What to Do if Your Fish are Sick?

If you suspect that fish are getting sick, the first thing to do is check the water quality. If you do not have a water quality test kit, contact your county extension office; some counties have been issued these kits, and your extension agent may be able to help you. If your county is not equipped with a water quality test kit, call the aquaculture extension specialist nearest to you (see the list at the end of this publication). Anyone contemplating commercial production of fish should invest in a water quality test kit and learn how to use it. An entry level kit for freshwater aquaculture can be purchased for about $200, and can save thousands of dollars worth of fish with its first use. Low oxygen is a frequent cause of fish mortality in ponds, especially in the summer. High levels of ammonia are also commonly associated with disease outbreaks when fish are crowded in vats or tanks.

Separate extension fact sheets are available that explain oxygen cycles, ammonia cycles, and management of these water quality problems. In general, check dissolved oxygen, ammonia, nitrite, and pH, during a minimum water quality screen associated with a fish disease outbreak. The parameters of significance include total alkalinity, total hardness, nitrate (saltwater systems) and chlorine (if using city water). Ideally, daily records should be available for immediate reference when a fish disease outbreak occurs.

These should include the dates fish were stocked, size of fish at stocking, source of fish, feeding rate, growth rate, daily mortality and water quality. This information is needed by the aquaculture specialist working with you to solve your fish disease problem. Good records, a description of behavioral and physical signs exhibited by sick fish, and results of water quality tests provide a complete case history for the diagnostician working on your case.

Professional assistance is available to Florida residents through the Florida Cooperative Extension Service, Institute of Food and Agricultural Sciences (IFAS) at the University of Florida; the Department of Agriculture and Consumer Services, Division of Animal Industries and Division of Aquaculture, as well as several private laboratories and veterinary practices. A list of public resources is included at the end of this publication.
If you decide to submit fish to a diagnostic laboratory you should collect live, sick fish, place them in a freezer bag (without water), and ship them on ice to the nearest facility. Small fish can be shipped alive by placing them in plastic bags which are partially filled (30%) with water. Oxygen gas can be injected into the bag prior to sealing it. An insulated container is recommended for shipping live, bagged fish as temperature fluctuations during transit are minimized. In addition to fish samples, a water sample collected in a clean jar should also be submitted. Detailed information on submitting samples is available in UF/IFAS Fact Sheet FA-55, Submission of Fish for Diagnostic Evaluation.

**Short Answer Type Questions**

1. Name the parasitic disease of fish.
2. Write any two examples of ectoparasites of fish.
3. What are endoparasites? Write any two types of endoparasites.
4. Name any two common viral disease of fish.
5. Which bacteria are the furuculosius and columnaris disease of fish.
6. Which bacteria are causes the dropsy disease in fishes. Write main symptoms of the disease.
7. Name any two fungal disease of fish and write their disease causing parasites.
8. Write any two protozoan disease of fish.
9. Write the names of helminthic disease which you have studied.
10. Write the main difference between male and female anchor worm.
11. Expand E.U.S which dishes are initially effected by this disease.
12. Define ‘Eutrophication’.
13. Depletion of oxygen takes place in the culture ponds what will happen.
14. Expand SEMBV.
15. Name any two viral disease of shrimp.
17. What is Acidosis and Alkalosis?
18. What are chemical agents are used in Chemotherapy to prevent the bacteria in aquaculture.

Long Answer Type Questions

1. Explain any three viral disease of fish.

2. Describe the common bacterial disease of fishes.

3. Write the symptoms and control measures of fungal disease found in fishes.

4. Explain the viral disease of shrimp and their prevention and control.

5. Describe the common fungal disease found in shrimp.

6. Explain the environmental disease of shrimp.

7. Explain the methods for disease diagnosis fishes.

8. Describe the good health management of fishes.

O.J.T

1. Diagnosis of common fish and prawn disease of infected specimens or by charts.

2. Discuss the principle of fish health management.
8.1 Introduction

8.2 Daily Management

8.3 Monthly Management

8.4 Reason for fish and prawn kills

Learning Objectives

After the completion of this unit the student will able to

- Know the importance of routine pond management
- Understand the daily and monthly management practices
- Know the reasons for fish and prawn kills

8.1 Introduction

After the ponds are management of ponds includes

1. Feeding and fertilizing
2. Keeping the pond in good condition
3. Detecting the troubles and disease

Every pond requires supervision in the above areas. Any good management requires checking of the condition of the fish and the pond regularly. It requires daily and monthly management.
8.2 Daily Management

Ponds are fish must be taken care of every day. Everyday the ponds should be checked, especially in the morning because oxygen levels in the water are lowest then and fishes are more likely to have trouble at that time. The following should be checked everyday.

1. **Checking of leakage in ponds**: Check all walls, gates inlets and outlets. Walls can erode, especially after heavy rains. Little leaks get larger quickly.

2. **Clearing of filters**: The filters in the pond must be removed and cleaned of silt, leaves and other material that are deposited in them.

3. **Watching fish**: The fishes should be watched carefully everyday. If they are swimming quickly and easily and around the pond, they are well. If they are loitering near the surface they are likely to be hungry. If they are hastrping for breath at the surface of the water, there is not enough oxygen, in which case the pond should be aerated as early as possible.

4. **Feeding**: Good amount of natural food should be available to the fish, otherwise the supplementary food should be provided. The supplementary food is given by
   - Spreading the food on the surface
   - Placing the food inside a floating bamboo or rope feeding ring
   - Pressing the food into dry pellets and adding to the pond.

Always feed the fish, at the same time and in the same part of the pond. The fish will learn where to go get food. Do not overfeed the fish. Determine how much food the fish should be fed with. Inmost of the cases feeding is at the rate of 2-5% of body weight per day. For example 100 fingerlings weighing 6 gm each, will have a fish should be fed only 6 days in a week, so that the fish get a chance to feed on whatever food remain in the pond. The fish should not be before harvesting or breeding.

1. **Fertilization of the pond**: The water should be watched carefully every day. If a healthy oxygen colour is found, it is fertile pond and fertilizers need not be added if the water is brown in colour then the fertilizer is needed.

2. **Watch for predators**: Check the pond area of snake hole, rat burrows and eels. Check the screen at the inlets for predators. These are dangerous to fish.

All these pond management practices do not take much each day, and therefore it is absolutely necessary to check to all these items everyday so as to
reap a good harvest.

### 8.3 Monthly Management

The ponds which are managed well day by day will require little other treatment. However the following aspects will probably require more attention on a monthly basis.

- Check the pond wall cut the grass on embankment.
- Check the pond bottom. If there is too much buildup of silt and organic matter. Scoop this material out.
- Check for the remove the aquatic weeds.
- Check the inlets and outlets. Make sure that the water can flow smoothly in and out of the pond.
- Check the fertility and turbidity of the water. If the pond is not fertile, fertilizers should be added to the water.
- Check the fish carefully for signs of disease and proper growth of the fishes.
- Add lime if needed.

### 8.4 Reasons for fish and prawn kills

Aquatic organism are very sensitive to anyone change of water quality. It is difficult to estimate the exact reason for fish or prawn kills. I is objected to various reasons, by thier in doubt the various changes brought about in he ecological conditions of water, parasitic, non-parasitic and nutritional problems prove harmful and even fatal to fish or prawn.

The following aspects are responsive for the reasons of the fish and prawn kills.

1. Due to improper management of water quality.
2. Infected by diseased pathogens.
3. Depletion of oxygen in the culture pond.
4. Excess fo carbondioxide.
5. Acclamation of Ammonia and nitrogen waste
6. Due to water contaminated pesticides or any toxicants.
7. Water contaminated by agriculture or industrial pollutants.
8. Due to high temperature
9. **Eutrophication**: Accumulation of high nutrients water body looks pea-soap green in colour due to algal blooms. Excess growth of algal blooms leading to death of fish.

10. **Algal toxicosis**: Persistence of the algal bloom will cause toxicosis for the fish or prawn stock showing symptoms like convulsions leading to death.

11. Excess of hydrogen sulphide gas-pond smells like rotten eggs. The bottom dwelling fish or prawn come up the surface and die first.

12. Very low or high levels of pH.

13. Man nutritional problem or improper feeding

14. Due to high stocking density

15. Infection of appliances and feeding trays

16. The entry of predatory fish (like channa, murrels, clarias, Notopterus, mystes species etc.) and fish predators (Like frogs, water snakes, aquatic birds e.g. : Pelican, fish eagles, Henons and king fishers, aquatic mammals like otter etc.) as they kill and feel up on the young fish and prawns.

### Short Answer Type Question

1. What type of supervision requires for good management of pond?

2. Write any important steps in daily management of pond.

3. Write any two important monthly management practices.

4. Write about good feeding methods.

5. Write any two reasons for fish and prawn kills.

6. Define ‘Eutrophication’. Write its adverse effect on fish culture.

7. Give any examples of predatory fish and fish predators.

### Long Answer Type Question

1. List out the management of culture pond.

2. Explain the daily management of stocking ponds.

3. Explain the reason for fish and prawn kills.

### O.J.T

1. Learn and practices the daily and monthly management of ponds.

2. Identity the reasons for fish or prawn kills.