INTRODUCTION TO FISH POND CONSTRUCTION AND MANAGEMENT (2 UNITS)

FIS 312

LECTURE GUIDE

BY:

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POND MAINTENANCE

Once the ponds have been stocked, it is important that the fish are checked every day for signs of stress and the farm in general for any maintenance that might be required. Both activities are preventive measure that should reduce risk of something going wrong around the farm. Those routine inspections should preferably take place during the early morning when the oxygen levels tend to be at lowest and the first most likely to be stressed. It is also good practice to carry out the inspection again most time of feeding as the fish can be observed most easily.

During the inspection, the following should be checked and records of the observations kept:

- Fish mortalities
- Physical and chemical characteristics of waters, particularly oxygen levels. If facilities are available, the farmer should endeavor to monitor climatic production on the farm as well as water quality parameters.
- Check whether fertilization of each pond is necessary.
- Behavior of fish, particularly for signs of stress e.g. gasping signifies low oxygen levels, poor feeding, errative swimming, lethargy and disease.
- Pond banks, dams, monks, and outlets for signs of erosion and for leaks. These can get progressively larger if not quickly dealt with.
- Screens, filters and outlets for debris and blockage which should be subsequently cleared.
- Excessive weed growth and potential problems.
- Predators such as snake, lizards, birds and frogs in and around the pond which should be eradicated if possible.

WATER QUALITY MAINTENANCE

The survival, growth and consequent production of fish depend to a large extent on the physical, chemical and biological status of the water in the culture enclosure. Therefore, the fish farmer must possess the ability to detect and product quantitatively changes in the limnological status of the water and the effects of different fish farming activities on fish production.

Depth: Depth of water in the pond must be kept steady through regular replenishment with fresh clean water to top up for water host by seepaye and evaporation. Low water levels expose fish to the vagaries of predation and extreme temperature fluctuation. High diurnal water temperature associated with shallow grow-out pods (<0.5m) often causes early maturity and stunting in fish. If water level is allowed to rise uncontrolled, it may overflow and eventually break down the dam.

Transparency: The secchi disc (a small disc with black and white sectors on the upper surface) is the instrument used for measuring turbidity or water transparency. A seechi disc transparency ranging between 30cm and 50cm is optimal for fish production in ponds. A high transparency (>80cm) is an index of low production. This can be improved by adding fertilizers. Low transparency (<20cm) may be due to suspended silt, clay, plankton or organic matter. This also encourages low fish production, low transparency due to sand and silt suspension can be avoided by allowing water to flow through a settling or sedimentation system before entering the culture pond and by grassing the perimeter of pond. If low transparency is due to excessive growth of plankton, which is evidenced by the deep green colouration of the water, this can be improved by stopping fertilizer application and use of algrade if necessary.

Dissolved Oxygen: Maintenance of sufficient dissolved oxygen in the fish pond at all times is without doubt, the most essential of water quality management tasks performed by the fish farmers.

It is re commended that the dissolved oxygen level is measured in the early morning and again 14:00 hours. For minimal stress and good growth it should be above 4-5mg//. If the oxygen content falls below this level it will be necessary to aerate the water between dusk and dawn, and, if necessary in the afternoon.

In intensive culture high fish density, continous aeration may be necessary because the oxygen produced by the plants is usually not sufficient to meet the needs of all the fish. The dissolved oxygen content is inversely proportional to temperature, and high temperature during the early afternoon may cause the oxygen content to fall below the critical level.

Aeration can be achieved in a number of ways, but the method used will depend on financial resources, access to electricity and intensity of production.

pH: water with a pH range of 6.5-8.0 is most suitable for fish production. Since fish can tolerate the temporary increase in pH of the water that occur during the day because of the dissociation of carbon dioxide more than temporary depression of the pH of the water during the night, it is recommended that the pH of the water in the early morning should not be lower than 6.5. Low pH can be improved through the addition of lime while high pH can be lowered through addition of ammonium sulphate, ammonium nitrate and urea fertilizers.

Smell: Any bad small emanating from the pond or production unit is indicative of a problem. Bad smells from the water are most probably gaseous products of anaerobic breakdown of nutrients in the water and are most often toxic to fish. This can be improved by stopping nutrient input and or aeration. As a last resort lowering the water in the pond and replenishing with fresh clean water should be considered. Unfortunately, this alternative may not always be available particularly during the drought season, therefore careful control over supplementary feeding and fertilization are critical to avoid the production.

Pollutants: With industrialization, intensification agriculture and wide spread use of industrial and agro-chemicals and detergents, it is inevitable that some of the waste products of these ventures find their way into local surface and underground water bodies by run-off or surface and eventually into fish ponds.

The presence of by-products of various activities of man which are pollutants in the pond are evident from the observation of oil films, scum and foam in the surface of the water and at the extreme, fish kills. Oil from workshops, generators and far, vehicles should be prevented from being washed into culture ponds.

As a rule, water flowing ponds must be ahaibysed routinely for pollutants including fertilizers and pesticides. If water in the pond is found to be polluted, it should be drained and replenished with fresh and clean water, preferably from an alternative source.

WEED CONTROL

Aquatic weeds are macroscopic plants called Macrophytes which grow in water and whose existence, especially in large quantities, may interfere with fish pond management operations such as feeding, test cropping and harvesting. They compete with phytoplankton for available nutrients thereby depriving planktorous fishes of their natural food, provide havens for pond pest and encourage evapo-transpiration. Aquatic weeds include floating plants e.g. *pista stratiotes* (water lettuces), pond weed (*Lemma spp)* and filamentous algae, submerged weeds e.g. *ceratophylum*, emergent plants e.g. water lilly (*Nymphea lotus)* and marginal or fringe vegetation.

Submerged and emergent weeds can be effectively checked through fertilizer application. This encourages dense plankton growth shading off the pond bottom, thereby cutting off the supply of solar energy to these plants. This technique is quite effective if the pond is constructed in such a way that no part of is shallower than 60cm. herbicides are also used for controlling aquatic weeds in ponds. Usually the concentration of herbicides used to kill the weeds are safe for fish but the decay of the weeds killed by the herbicides often cause dissolved oxygen depletion which may be deleterious to fish production. A major disadvantage in the use of herbicides in the control of aquatic weeds is that once the concentration of the herbicides drops below levels toxic to the weeds, the weeds will re-grow thereby necessitating repeat applications. Copper sulphate and synthetic algicides e.g. Simazinbe and Aquazine can be used to control excessive growth of filamentous algae and phytoplankton. The use of copper sulphate and synthetic algicides also create low dissolved oxygen levels after their application. Synthetic algicides tend to have longer residual action when compared with the use of copper sulphate in the control of filamentous algae and phytoplankton.

Biological control of aquatic weeds through the introduction of grass eating fish such as grass carp *(tenopharngoden idella)*, *Tilapia zilli* and *Heterotis niliticus* is most often recommended in poly-culture systems. Aquatic weeds can also be controlled through manual removal or mechanically through the use of specially designed amphibious machines.

LIMING

About two weeks before refilling the pond, a layer of lime should be spread over the pond bottom and thoroughly worked into the surface layer. Liming serves several functions parts of which are the following:

- It raises the pH of acidic soils and pond water which tend to restrict fish growth.
- Although not a fertilizer, it helps to accelerate decomposition of waste materials and the mobilization of nutrients from the pond soil.
- It raises the pH above tolerate limits disease vectors or eggs and spores of parasites, thus assisting in their eradication.

Lime comes in several forms and the application rates depend on the pH of the soil and the type of lime used. It is essential that excess lime is not used as this tends to back up phosphate although the formation of insoluble calcium compounds. In ponds where the soil pH is around neutral the application rates are of the order listed below:

Crushed Limestone	$CaCo_3$	$1200kg/ha^{-1}$
Agricultural Lime	$CaCo_3$	$2500kg/ha^{-1}$
Hydrated Lime	$CaCo_3$	$100kg/ha^{-1}$
Quicklime	$CaCo_3$	$200kg/ha^{-1}$

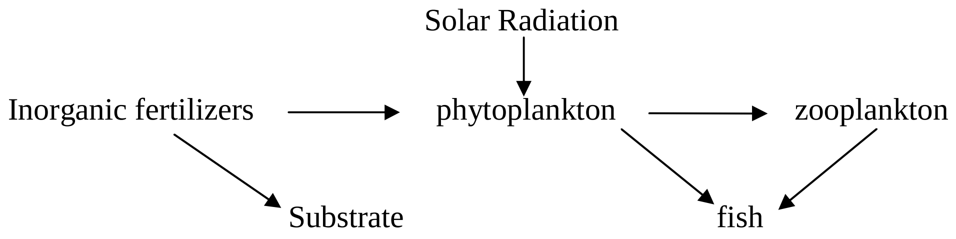
If the pond has a pH of about 4.5 or less, approximately 4.5tonnes of agricultural lime will be required. If the pond has been limed before, subsequent annual liming is usually much less i.e. 20-25% of the initial application rate. Hydrated lime is the best because it tends to be the most concentrated and cheapest form. Care should be taken if quicklime is used because it can burn on contact with the skin.

FERTILIZATION

The yield of any fish pond depends in its natural productivity, which is linked to nutrient availability in the pond soil and water. It thus allows an increase in fish density without the need for supplementary feeds. The most important nutrients for growth of food organisms are Phosphorus (P), Nitrogen (N), and Potassium (K). if these nutrients are in short supply or absent, they can easily be increased by fertilization using organic and inorganic substances. Fertilizers are applied to the pond water or soil to stimulate and maintain plant growth and establish the secondary food chain. However, the mechanisms of organic and inorganic fertilizers in achieving this production are quite different.

Inorganic Fertilizers

Inorganic fertilizers usually of chemical origin that dissolve in the pond water and provide nutrients almost immediately. This stimulates phytoplankton (algal) growth and zooplankton production, both of which are direct sources of feed for fish.

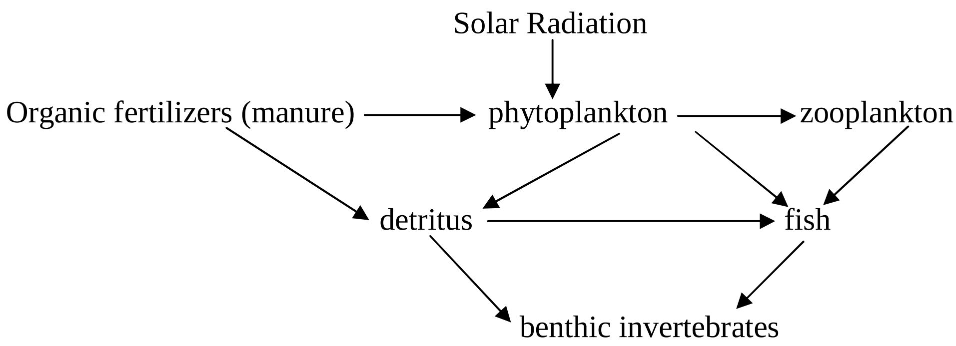


A simple food chain based on inorganic fertilization of a pond.

Originally, inorganic fertilizers applied the three main nutrients in various mixtures and are known as NPK fertilizers. Some typical fertilizers are 20-20-20 (NPK) or 20-20-5 (NPK) which simply refers to the mixture of each component in the bag. For example, 20-20-5 refers to a mixture of 20 parts nitrogen, 20 parts phosphorus and 5 parts potassium. More recently it has been shown that the main limiting element in establishment ponds is phosphorus, and this can be provided in several forms, including basic slag, powered single super-phosphate or granular triple super-phosphate.

Organic Fertilizers

Organic fertilizers are usually waste plant or animal products including manures from cars, pigs, sheep, ducks, chickens and humans, grasses or the non-utilized parts of crops such as rice husk that have rotted down. As this mechanism of fertilizers is the basis of integrated fish farming. The important points to remember about organic fertilizers are they act slowly as they rot down and release the nutrients, as a result they stimulates both the autotrophic and detrital pathways for nutrient release a production of food for fish. Some fish also feed on the manure, explaining the surface bacteria as a food source.



A simple food chain based on organic fertilizers of a pond

Application Rates

The rate of application of either organic or inorganic fertilizers is a variable function depending on the type of pond, its age and its condition. For the first fertilizer added to a new pond, some common rates of application are listed below.

Common rates of vertebrates' application for new ponds

Fertilizer (Organic)	**Nursery Pond Kg/ha^{-1}**	**Production Kg/ha^{-1}**	**Ponds frequency**
Cow dung	500-700	300-500	Weekly
Pig dung	500-700	600-1200	Weekly
Chicken dung	500-700	100-230	Weekly
Fertilizer (Inorganic)			
20-20-20	20-40	40-50	Bi-Weekly

In other ponds, the rate of production can be reduced considerably because many of the nutrients are recycled, particularly after draining and preparation of the pond bottom.

TEST CROPPING

Test cropping is the act of checking the survival, growth and productivity of fish species in a fish farming system. This is why important in pond maintenance of fish culture in order to avoid high mortality rate due to cannibalism and other factors.

During this exercise, the following are observed:

(1) Disease status of the fish to avoid contamination.

(2) Handle n the fish as careful as possible.

(3) Prevent the fish from becoming too warm through exposure to sunlight.

(4) Separate the fish sizes and group into different ponds approximately.

(5) Use the appropriate net to remove the fish from the pond without damaging their body system.

(6) The bucket containing water must be nearby by to keep the fish alive during examination.

(7) To avoid stress, this exercise should be carried out once a month or bi-monthly.

HARVESTING

Harvesting is the removal of cultured animal from a culture system. Most warm water cultured fish should be ready for harvesting within six to nine months of culture depending on the species, size at stocking and level of management. The specific time for final harvesting can be determined after test-cropping to find out when at least half of the stock are of marketable size (300-500) body weight for carp or (200-250g for tilapia).

Harvesting can take place for reasons, such as, for experimental purpose, for pathological reasons, purpose for sale or transference to other farm.

Types of Harvesting

(1) **Partial Harvesting**: Entails partial removal of the cultured animals. The level of the pond water is usually achieved to a desired level so as to enable easy wadding of fishermen through the removal of cultured animal in the pond.

(2) **Complete Harvesting:** Water is removed completely and total removal of all or some of the cultured fishes is achieved.

Criteria considered during harvesting

(1) The type of gear to be used.

(2) The shape of the pond.

(3) The size and type of the fish.

(4) Time of the harvest.