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.

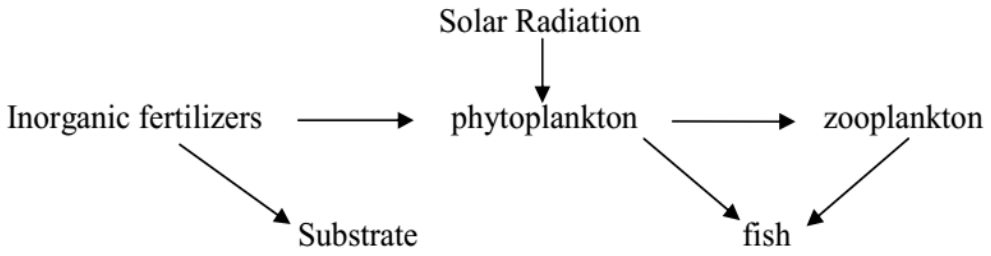
FERTILIZATION

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.

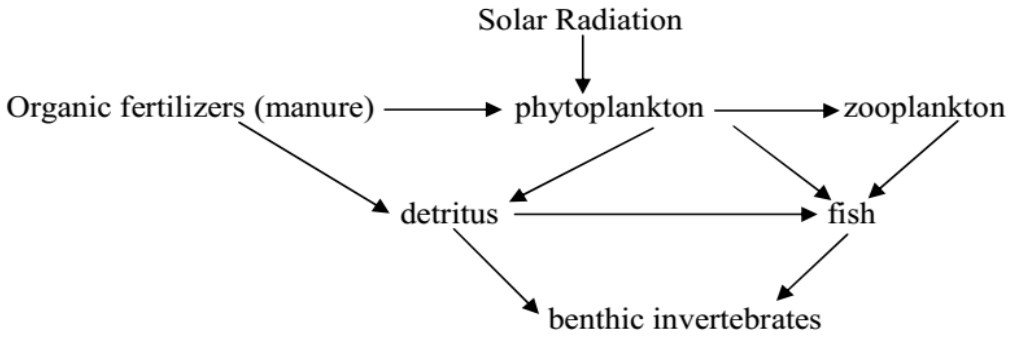


A simple food chain based on inorganic fertilization of a pond.

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.