

FISH NUTRITION
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WEEK1- FOOD TYPES FOR FISHES

- Natural food
- Supplementary feeds
 - Complete feeds

WEEK 1-CONT.

- **Natural food** is found naturally in the pond. It may include **detritus***, **bacteria***, **plankton***, worms, insects, snails, aquatic plants and fish. Their abundance greatly depends on water quality. Liming and fertilization, in particular organic fertilization, can help you to provide a good supply of natural food to your fish.
- **Supplementary feeds** are feeds regularly distributed to the fish in the pond. They usually consist of cheap materials locally available such as terrestrial plants, kitchen wastes or agricultural by-products.
- **Complete feeds** may also be regularly distributed. They are made from a mixture of carefully selected ingredients to provide all the nutrients necessary for the fish to grow well. They must be made in a form which the fish find easy to eat and digest. These feeds are quite difficult to make on the farm and are usually quite expensive to buy.

WEEK2-*System of production*

System of production can be defined according to the type of food given to the fish.

Extensive: fish production depends entirely on natural food;

Semi-intensive: fish production depends on both natural food and supplementary feed; more fish may be reared in the pond;

Intensive: fish production depends entirely on complete feed, and the stocking rate no longer depends on food availability but on other factors such as water quality.

WEEK3-Natural foods for fish

- 1. Natural fish foods present in a fish pond are very diverse and usually consist of a complex mixture of ***plants and animals***.
- (a) They range from microscopic to relatively large size.
- (b) They may be alive or dead (***detritus***) and available from bacterial decomposition.
- (c) They are generally present in various parts of the pond:
 - near the shore such as ***rooted high plants***;
 - floating in the water such as ***plankton***;
 - on the surface of or within the bottom (***benthic material or benthos****) such as worms, insect larvae and snails;
 - covering the surface of submerged objects (***biological cover or autwuchs****);
 - swimming around such as aquatic insects, frogs and fish (***nekton****).

WEEK4-Fish Feeding Characteristics

- ***Fish larvae*** do not actively feed but survive on reserve food in their yolk sac. A short time before the yolk sac is absorbed, ***early fry*** start eating natural foods, which usually consist first of the smallest plankton such as microscopic algae and rotifers. As their mouth size increases, the fry eat increasingly larger plankton (cladoceres/copepods) and insect larvae/pupae. Little by little, as the fry grow older, food preferences change to resemble more and more those of adult fish.

WEEK5-Fish Feeding TYPES

- (a) **Herbivores** prefer plant materials such as: **phytoplankton***, for example the Chinese silver carp;
- **higher plants**, for example Tilapia rendalli, grass carp, and the Asian cyprinid *Puntius*.
- (b) **Omnivores** eat a mixture of various natural foods, although most of them have preferences for certain foods such as:
 - **zooplankton***, for example the Chinese bighead carp;
 - **bottom fauna**, for example common carp;
 - **bottom detritus** for example mrigal, an Indian cyprinid;
 - **phytoplankton**, for example the Nile tilapia;
 - **fruits and seeds**, for example the South American *Colossoma*.
- (c) **Carnivores** prefer animal food such as insects, tadpoles, frogs and smaller fish, for example trout and catfishes such as African *Clarias* and Asian *Pangasius*.

WEEK6-Supplementary feeds

- Why we use supplementary feeds?
- when ***natural foods become insufficient*** to feed your fish well and ensure good growth; and
- when you wish ***to raise more fish*** in your pond to produce a higher crop and still have good growth.
- As you make more use of supplementary feeds, you change from an ***extensive system*** to a ***semi-intensive system*** of production.

WEEK6-Examples of supplementary feeds (cont.)

- **terrestrial plants:** grasses, legumes, leaves and seeds of leguminous shrubs and trees , fruits, vegetables;
- **aquatic plants:** water hyacinth, water lettuce, duckweed;
- **small terrestrial animals:** earthworms, termites, snails;
- **aquatic animals:** worms, tadpoles, frogs, trash fish; **rice:** broken, polishings, bran, hulls;
- **wheat:** middlings, bran; **maize:** gluten feed, gluten meal;
- **Oil/cakes** after extraction of oil from seeds of mustard, coconut, groundnut, African palm, cotton, sunflower, soybean; **sugar cane:** molasses, filter-press cake, bagasses;
- **coffee pulp; cottonseeds; brewery** wastes and yeast;
- **kitchen** wastes;
- **slaughterhouse wastes:** offals, blood, rumen contents;
- **silkworm pupae;**
- **manure:** chicken droppings, pig manure .
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WEEK7- *Food conversion ratio (FCR)*

- The ***food conversion ratio (FCR)*** is the ratio of the quantity of food distributed (in kg) to the weight gain of fish (in kg), over the same period of time.
- The FCR can vary considerably, usually depending on the same factors affecting daily feeding rate, such as species, kind of feed, water quality and natural food availability. Remember that ***the lower the FCR, the better the feed is being utilized*** by your fish.

WEEK7- FCR (Cont.)

- Example
- Over a period of one month, the fish biomass has increased by 12 kg. The quantity of supplementary feed distributed has been 48 kg. **FCR** = $48 \text{ kg} / 12 \text{ kg} = 4$. FCR=4

****the lower the FCR, the better the feed is being utilized by your fish****

WEEK8-STOPPING FEEDING

- There are several occasions on which it is advantageous or even compulsory ***to stop feeding your fish:***
- when ***the water temperature*** is too low or too high;
- when ***dissolved oxygen content*** is limited;
- on the day you ***apply manure*** to the pond ;
- if ever a ***disease epidemic*** appears in the pond.

WEEK9-HATCHERY FEEDS

- Specialised feeds are produced for [fish hatcheries](#). In species such as salmon and trout, the newly hatched [fry](#) first feed from their [yolk sacs](#) and then can be fed with starter feeds. Marine species such as sea bass, sea bream, flounders and turbot consume the nutrition in their yolk sacs during the first few days post hatching and then are fed for several weeks on live prey, the form of [rotifers](#) and [brine shrimp](#) (Artemia). Special feeds can be used to enrich the nutritional value of the prey. Rotifers are usually bred in the hatchery while brine shrimp are generally collected from the wild, e.g. salt lakes. Manufactured feed alternatives to brine shrimp are becoming available, offering more consistent nutrition and improved sustainability as demand increases with the growth of aquaculture.

WEEK 10-DRY FEEDS

- Modern fish feeds are made by grinding and mixing together ingredients such as fishmeal, vegetable proteins and binding agents such as wheat. Water is added and the resulting paste is [extruded](#) through holes in a metal plate. The diameter of the holes sets the diameter of the pellets, which can range from less than a millimetre to over a centimetre. As the feed is extruded it is cut to form [pellets](#) of the required length. The pellets are dried and oils are added. Adjusting parameters such as temperature and pressure enables the manufacturers to make pellets that suit different fish farming methods, for example feeds that float or sink slowly and feeds suited to recirculation systems. The dry feed pellets are stable for relatively long periods, for convenient storage and distribution. Feeds are delivered in bulk, in large bags—usually one tonne, or in 25 kilogram bags. Smaller quantities of specialist feeds are supplied for use in fish hatcheries.

WEEK11-FISH MEAL AND FISH OIL

- Traditionally two of the most important ingredients have been [fishmeal](#) and [fish oil](#). These come mainly from the processing of fish from the [wild catch](#), usually [pelagic species](#) that are generally not suited to processing for human consumption. Fish sold for human consumption attract a higher price than those used to make fishmeal. The fishmeal fisheries are often referred to as reduction fisheries. The world's largest reduction fishery is in the Pacific, off the coast of Peru and Chile and is regulated by the governments of those countries. The North Atlantic is another important source of fish for fishmeal and fish oil.

WEEK12-FISH MEAL AND FISH OIL (Cont.)

- Fishmeal is a brown, flour-like material made by specialist producers that cook, press, dry and grind the fish. The fish oil is effectively a by-product of this process that proves to be a rich source of energy and fatty acids for fish, including the important long-chain [omega-3 fatty acids](#) EPA and DHA now linked to the health benefits associated with eating oily fish such as salmon and mackerel.

WEEK 13- FEED STUFF

- **Protein**
- Protein is the most expensive component of fish feed. It is important to accurately determine the protein requirements for each species and life stage cultured. Proteins are formed by linkages of individual amino acids. Although more than 200 amino acids occur in nature, only about 20 amino acids are common. Of these, 10 are essential (indispensable) amino acids that cannot be synthesized by fish. The
- 10 essential amino acids that must be supplied by the diet are ***methionine, arginine, threonine, tryptophan, histidine, isoleucine, lysine, leucine, valine, and phenylalanine. Of these, lysine and methionine are often the first limiting amino acids.***

WEEK14-FEED STUFF (Cont.)

- Lipids (fats) are high-energy nutrients that can be utilized to partially spare (substitute for) protein in aquaculture feeds. Lipids have about twice the energy density of proteins and carbohydrates. Lipids typically make up about 7-15 percent of fish diets, supply essential fatty acids, and serve as transporters for fat- soluble vitamins.
- Carbohydrates (starches and sugars) are the least expensive sources of energy for fish diets. Although not essential, carbohydrates are included in aquaculture diets to reduce feed costs and for their binding activity during feed manufacturing. Dietary starches are useful in the extrusion manufacture of floating feeds. Cooking starch during the extrusion process makes it more biologically available to fish.