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FEED MANAGEMENT IN CAGE CULTURE

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Introduction

The sustainability, profitability and well-being of aquaculture systems depend on the feed quality and feeding practices. The adequate supply of nutrients, both in quantity and quality are essential for growth, health and reproduction of fish and other aquatic animals. Hence, feeds used should be nutritionally balanced, highly digestible and economical for the species cultured.

In addition to the quality feed, feeding management is also equally important for the sustainability of cage culture. For maximum production and profits, farmers are interested in a high rate of feed consumption. However, the loss of nutrients, if feed is not consumed immediately and uneaten or excess feed represent an economic loss as well as a possible source of environmental pollution. Thus, feed should be fed in such a way as to minimize waste, optimize growth, allow for efficient conversion, minimize stress and maintain fish health.

The cultured fish organisms, their nutritional requirements, feeding behavior are the most important factors to be considered during feed management. In marine fish culture techniques developed (Cage culture) by CMFRI following species have been successfully tested so far.

1) *Rachycentron canadum* (Cobia)
2) *Trachinotus blochii* (Silver pompano)
3) *Lates calcarifer* (Sea bass)
4) *Lutjanus argentimaculatus* (Mangrove red snapper)
5) *Acanthopagarus latus* (Sea bream)
6) *Panilurus polyphagus* (Spiny lobster)

Nutrient classes of aqua feed

Proteins and amino acids: The proteins are organic compounds comprised of conjugated amino acids in proportions that are characteristic of each protein. The protein is digested or hydrolyzed and releases free amino acids, which are absorbed from the intestinal tract and distributed by blood to organs and tissues. These amino acids are used by various tissues to synthesize new protein. A regular intake of protein or amino acids is required because amino acids are used continually by the fish, either to build new proteins (as during growth and reproduction) or to replace existing proteins (maintenance).

Carbohydrates: The carbohydrates are organic compounds composed of carbon, hydrogen and oxygen. They are one of the major classes of nutrients besides proteins and lipids. If carbohydrates are not provided in the diet, other compounds, such as protein and lipids, are catabolized for energy and for the synthesis of various biologically important compounds usually derived from carbohydrates.

Lipids and fatty acids: The dietary lipids are important sources of energy and of essential fatty acids (EFA) that are needed for normal growth and development. They also assist in the absorption of fat-soluble vitamins. Dietary lipids, mainly in the form of triacylglycerols, are hydrolyzed by digestive enzymes to a mixture of free fatty acids and 2-monoglycerides. These compounds are then absorbed and either used for the synthesis of various cellular components or catabolized for energy.

Vitamins: The vitamins are organic substances that are essential for growth, health, reproduction and maintenance, but required in small amounts. Since fish cannot synthesize vitamins l or can only synthesize in insufficient quantity for normal development, growth and maintenance, they must be supplied in the diet. Each vitamin performs a specific function in the body and one vitamin cannot substitute for or replace another vitamin.

Minerals: A mineral is an element found in ash when a food or body tissue is burnt. The minerals are classified into two groups based on the relative amounts needed in the diet: macrominerals, elements that are required in large amounts, and micro minerals or trace minerals, elements that are required in very small amounts. The general functions of minerals include: structural components of the skeletal system (such as Calcium (Ca), Phosphorus (P), Magnesium (Mg), Sodium (Na), and Potassium (K), components of organic compounds (such

as proteins and lipids), enzyme system activators (such as Zinc (Zn) and Copper (Cu)) and maintaining acid–base and osmotic balances (such as Na, K and Chloride (Cl)).

Nutritional requirements of the commercially important finfish and shellfish species for cage culture

The quantitative requirement of any food depends largely on its composition. The most efficient level of feeding is attained only when the correct supply of energy and essential nutrients is available in the proportions required by the fish for maintenance and growth. Any deviation from this 'ideal' composition will also change the quantitative food requirement.

Determination of correct feeding level for fishes is more difficult than farm animals, since the fish obtain part of their food supply from natural sources. Natural food has to be supplemented to meet the nutritional requirements of the fish.

Three components are thus involved in the nutrition of cultured fish:

(a) the food requirement of the fish (R);

(b) available natural food (F_n);

(c) supplementary feed (F_s), so that

$$\mathbf{R = F_n + F_s}$$

Determination of supplementary feeding level is less complex in flowing-water fish culture systems such as raceways and cage culture. Due to the rapid rate of water exchange, the production of natural food in such systems is negligible. All the nutritional requirements of the fish must, therefore, be supplied through feed from outside sources provided by the fish farmer, a situation similar to that of many farm animals. The feed in such systems has to be prepared according to the nutritional requirements of the cultured species.

Types of feed

The feed for fish culture is broadly categorized in three types viz. dry feed, moist feed and semi moist feed. The dry feeds are readily available in market and can also be prepared knowing the requirements of cultured fishes. It is generally available in steam pelleted, partially extruded (slow sinking), expanded & floating types (Fig. 1). These feeds can be used according to feeding type of the target fish species. Moist and semi moist feeds are normally

prepared using trash fishes, molluscans, crustaceans locally available (Fig. 2) and some additional supplements like binders etc. For moist & semi moist feeds, availability of trash fishes in local area and its quality (freshness) plays vital role. Some fishes have feeding habit of carnivorous type, in such cases chopped fish meat can be used. The farm made feeds can also be prepared by using the ingredient composition according to the nutritional requirement of the species cultured (Fig. 3,4 and 5).

Fig.1: **Dry feed- different sizes and types of formulated aquafeed**

Fig. 2: **Moist feed-Feed preparation by chopping the trash fish**

Fig. 3: **Selection of ingredients for the preparation of farm made feed**

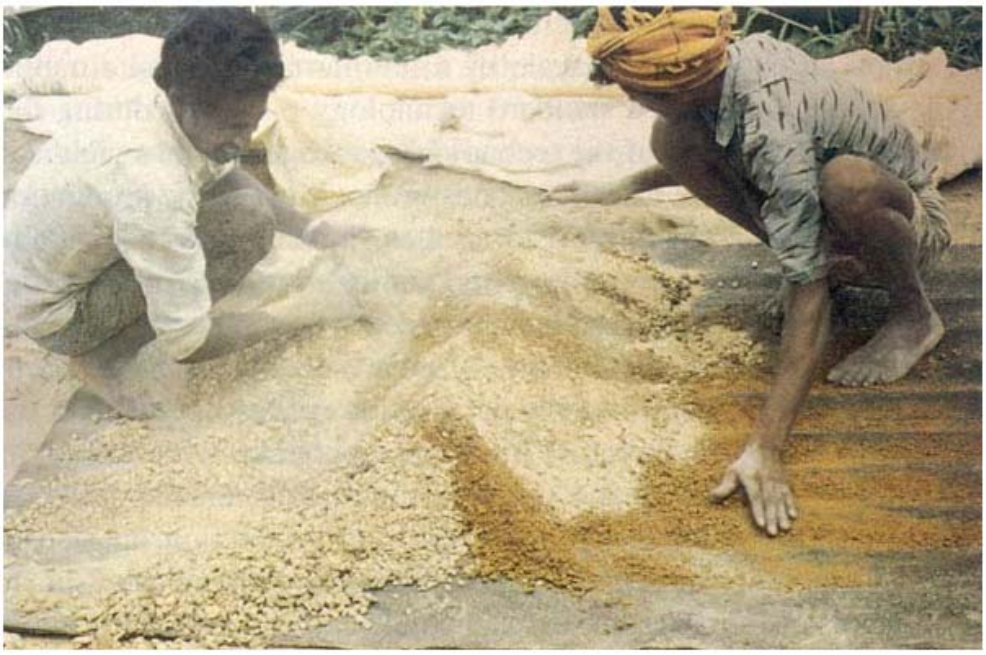

Fig. 4: **Mixing of ingredients for the preparation of farm made feed**

Fig. 5: **Making of feed balls**

Types of Feeding

The distribution of feed to the fishes is normally done manually. However, to cut labour cost in large scale farming, the use of demand and automatic feeders is also practiced. In such feeders amount of feed to be distributed and time of feeding can be adjusted as per requirements. But for small scale cage farms, manual distribution of feed is advisable rather than investing more money on demand or automatic feeders. Moreover, the loss during feeding is more by automatic or demand feeders in comparison to manual method of feeding.

Feeding rates

The feeding rate is calculated according to percentage body weight of the fish on per day basis. During initial stages of fishes (larval, fry, fingerlings) feeding rates are generally higher (5-10%) further it is reduced up to 3-4% per day as the fish grows up to harvest. The feeding rates are dependent on fish size and water temperature also.

Feeding frequency

The frequency is decided after finalizing the feeding rate. Suppose, fish stock is fed at the rate of 5% body weight per day. The quantity of feed to be fed at the rate is equally divided in 2-3 portions which are fed to the cultured stock in morning, afternoon and evening. The feeding the fishes in equal divided proportions of the feeding rate is known as feeding frequency. It helps in preventing overfeeding at a single time resulting in reducing loss of feed.

Feed Management

Since major operational expenditure goes towards feeds, the optimal conversion for feed for growth can be achieved only by efficient feed management. In this, feeding is controlled by defining amount of feed to be given to achieve optimal growth. For the purpose, calculation of Feed Conversion Ratio (FCR) is helpful. It renders the farmer to plan the returns from fish culture and also to diagnose the problems. FCR can be calculated by amount of feed given to fishes divided by the production in kg. More the FCR value less is the profit.

Following are some guidelines for effective feed management:

i) Observation of fishes during feeding. It indicates the overall health of fishes. Active feeding behavior indicates everything is all right. However, poor feeding response should always be viewed seriously.

ii) When temperature reduces suddenly, the feeding level should be reduced.

iii) Stop feeding during stormy or extremely calm weather conditions. These conditions can lead to low dissolved oxygen.

iv) Quality of feed must be ensured before procurement. Feed must be kept in cool, dry place, and utilized within three months of manufacture. For moist feeds and trash fishes, spoiled items should be avoided.

v) Install feeding trays for sinking feed and feeding rings for floating rings to reduce feed wastage.

vi) Prepare feeding schedule to avoid overfeeding. Feeding frequency should not be exceeded beyond 3.

vii) Regularly assess the quantity of fishes stocked in the cage and their weight for calculating the exact feed requirement.

viii) Do not over feed if the fishes are not consuming feed.

ix) Grading of fishes is important at regular intervals.

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