Agriculture, Fisheries and Conservation Department
Aquaculture Fisheries Division

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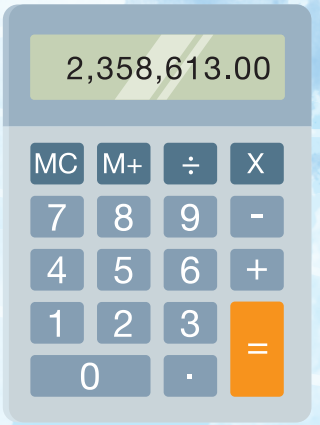
Good Aquaculture Practices Series 1

Fish Feed Management

漁農自然護理署
Agriculture, Fisheries and
Conservation Department

Introduction

Fish feed constitutes the major expenditure item of the aquaculture indutstry. Proper management of fish feed can help reduce the cost of aquaculture, improve the environment of fish farms, and ensure healthy growth of the cultured fish. Fish feed management includes selection of the appropriate feed, adoption of the correct feeding methods, calculation of the feed costs and assessment of the cost-effectiveness of fish farms.



1 Nutritional Requirements of Fish

Protein, fat, carbohydrates, vitamins and minerals are indispensable nutrients for fish.

Protein

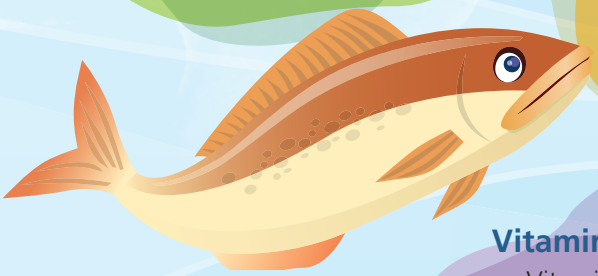
Protein provides fish with energy and contributes to muscle building. Insufficient protein intake will hinder growth while excessive protein will increase the feed costs.

Fat

Fat provides fish with energy. An appropriate amount of fat enhances the taste and texture of fish flesh while excessive fat will adversely affect their health.

Carbohydrates

Carbohydrates provide fish with energy but carnivorous marine species in general (such as groupers, red snappers and mangrove snappers) have difficulty in digesting most of the carbohydrates.



Vitamins and Minerals

Vitamins and minerals are indispensable trace elements that enhance resistance and improve the Feed Conversion Ratio (FCR) (please refer to page 17 for more information on FCR).

It is important to note that nutritional requirements vary among different fish species, sizes, growth stages and feeding habits. For example, carnivorous fish require higher levels of protein and fat as compared with omnivorous and herbivorous fish species, whereas marine fish require more protein and fat than pond fish. Therefore, the feed they require varies.

Table 1: Nutritional requirements of common cultured fish

Cultured Fish	Feeding Habit	Protein Requirement	Fat Requirement	Suitable Fish Feed
Big head carp	Planktivorous	18-23%	Below 5%	Water with a high plankton content/peanut cake meal
Grass carp	Herbivorous	18-23%	Below 5%	Grass/dry pellet feed with a low protein content
Scat	Omnivorous	24-33%	5-6%	Dry pellet feed with a medium protein content
Rabbit fish	Omnivorous	30%	5%	Dry pellet feed with a medium protein content
Sea bass	Carnivorous	38-42%	6-10%	Dry pellet feed
Grouper	Carnivorous	Above 45%	Above 10%	Dry pellet feed
Seabream	Carnivorous	40-45%	Below 5%	Dry pellet feed
Common whitefish (except seabream)	Carnivorous	40-45%	5-10%	Dry pellet feed

2 Common Fish Feeds

In Hong Kong, common fish feed includes the traditional vegetarian feed, trash fish, and dry pellet feed that has been widely used by the aquaculture industry in recent years.

Vegetarian feed

It includes wheat bran, rice bran, weeds, soy pulp, flour and peanut cake meal. It can be used to feed pond fish (herbivorous/omnivorous).

Trash fish

It refers to by-catch or small fish, which can be used to feed carnivorous or omnivorous marine fish.

Dry pellet feed

The main ingredient of dry pellet feed is trash fish. Dry pellet feed is made by grinding the oven-dried trash fish into fish powder, adding in fish oil, vitamins and binders, and finally extruding the mixture into puffed pellets.

3 How to Select Suitable Fish Feed

There is a wide variety of fish feed, but which one is most suitable for feeding cultured fish? To identify the type of fish feed which best caters for the specific needs of individual fish farms or cultured fish species, we may compare various factors, including the nutritional requirements of the cultured species, the availability, price and storage methods of the feed, the hygiene issues and the environmental impact.

3.1 Nutrition

Nutrients provided by vegetarian feed and trash fish may not fully meet the nutritional requirements of different cultured fish species, thus easily resulting in malnutrition of the fish stock, weakening of their resistance and an increase in the risk of disease infection.

Dry pellet feed can be compounded with animal or plant proteins, fish oils or other lipids, as well as vitamin premixes and minerals, with a view to meeting the nutritional requirements of various fish species and effectively improving their health.

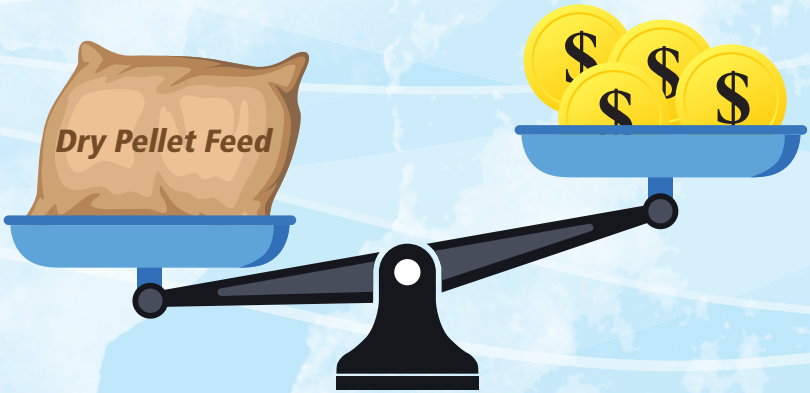
Fish feed dedicated to particular fish species (such as grouper, sea perch, and grey mullet) is also available on the market.

3.2 Availability

Dry pellet feed is stable in supply and convenient to store.

3.3 Price

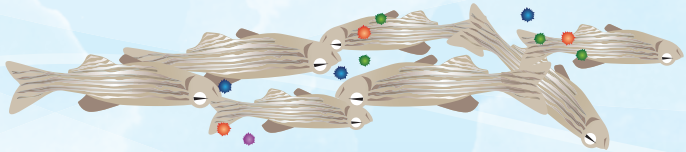
In general, vegetarian feed and trash fish are cheaper than dry pellet feed (please refer to page 17 for details).



3.4 Hygiene

Trash fish has a high moisture content and is prone to the proliferation of mould and bacteria. In addition, the fat of trash fish oxidises and rots easily, making it difficult to store. Should the cultured fish consume any bacteria-containing or rotten feed, they may become sick or even die.

Vegetarian feed has a low moisture content. Even though most of them are not preservative treated, they are less prone to bacterial or mould growth if stored properly.



The puffing process of dry pellet feed can kill most bacteria. With a low moisture content (about 10%), dry pellet feed does not rot easily and is convenient to store.

3.5 Storage methods

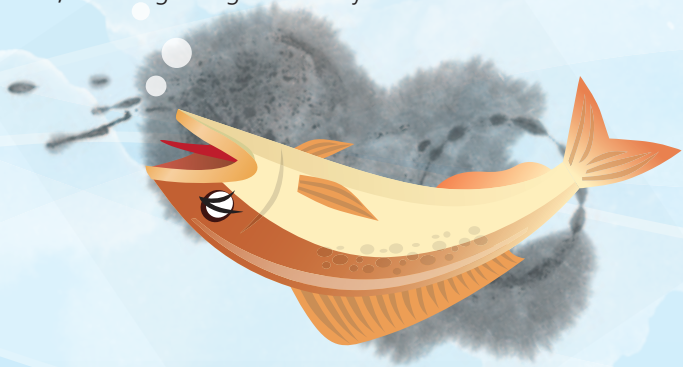
The low-moisture vegetarian feed and dry pellet feed can be stored in a covered cool dry place for two to three months.

The high-moisture trash fish can be kept frozen and stored at -20°C for about one week.

3.6 Environmental impact of fish feed

Powdery vegetarian feed will lead to deterioration of water quality if they remain suspended in the water for an extended period.

Trash fish, usually cut into varying sizes, has a high wastage rate (about 40%). The residues will accumulate on the seabed or pond bottom, not only causing pollution but also increasing the risk of anoxia in the fish farms, resulting in high mortality of the cultured fish.



Fish farmers can select dry pellet feed of the appropriate size and with the required nutritional content according to the different growth stages and feeding habits of various fish species.

Dry pellet feed is classified into two types, floating and sinking, and is available in a range of sizes for selection.

Table 2: Comparison of different types of fish feed

	Dry Pellet	Trash Fish	Vegetarian Feed
Main ingredients	Fish powder, fish oil, vitamins and binder 	Bycatch or small fish 	Flour, wheat bran, rice bran, weeds, soy pulp and peanut cake meal 
Storage	Can be kept for 2 to 3 months if stored in a covered cool dry place. 	Can be stored for about 1 week if frozen at -20°C. 	Can be kept for 2 to 3 months if stored in a covered cool dry place. 
Hygiene	The puffing process can kill most bacteria. The low moisture content (about 10%) can also prevent bacterial growth. 	The high moisture content (about 70%) makes it prone to the proliferation of bacteria or parasites. 	Not preservative treated. But with a low moisture content, it is less prone to bacterial or mould growth if stored properly. 
Nutrition	Can be compounded with animal or plant proteins, fish oils or other lipids, as well as vitamin premixes and minerals, with a view to meeting the nutritional requirements of various fish species and effectively improving their health. 	Nutrients provided by the feed may not fully meet the nutritional requirements of different cultured fish species, thus easily resulting in malnutrition of the fish stock, weakening their resistance and an increase in the risk of disease infection. 	
Environ-mental Impact	Allow feeding of an appropriate quantity of feed of a suitable size, thus minimising wastage and avoiding accumulation of excessive feed and pollution to the environment. 	Trash fish, being in varying sizes, has a high wastage rate (about 40%). The residues will pollute the seabed and the water. 	Suspension of excessive powdery feed in the water will lead to deterioration of water quality. 

4 Common Questions about the Use of Dry Pellet Feed

Bringing more benefits than other types of fish feed, dry pellet feed has been widely used by the aquaculture industry in recent years. Yet, many fish farmers still have doubts about the efficacy of dry pellet feed. We are going to address these concerns one by one in this section.

4.1 Do cultured fish fed with trash fish taste better?

It is commonly believed that cultured fish fed with trash fish seem to be better than those fed with dry pellet feed in terms of flesh quality and flavour, owing to the higher fat content in trash fish. As a matter of fact, fish farmers can formulate dry pellet feed according to the different nutritional requirements and growth stages of their cultured fish, and increase the fat content of the feed one to two months before harvesting their stock so as to enhance the flavour and flesh quality of the fish.

4.2 Do fish fed with dry pellet feed grow at a slower pace and discoloured?

Fish farmers can adjust the nutrient content of the dry pellet feed and prepare the dry pellet feed that best meets the nutrient needs of their cultured fish at various growth stages. Therefore, as compared with the use of trash fish as feed, the use of dry pellet feed enables the cultured fish to grow faster and healthier, thereby increasing the fish yields.

Feeding with dry pellet feed

4.3 How to switch to dry pellet feed?

With a low moisture content, dry pellet feed is harder in texture and cultured fish originally fed with trash fish may not be able to adapt to the new type of feed instantly. Therefore, at the initial stage of switching to dry pellet feed, the response of the cultured fish to the intake of feed may be slower. The following methods can be adopted to assist the cultured fish in adapting to this type of feed more quickly:

- Stop feeding the fish for one to two days before introducing dry pellet feed.
- Soften the dry pellet feed by soaking the feed in water first.
- Use a mixture of trash fish and dry pellet feed initially, and then gradually reduce the proportion of trash fish every day.

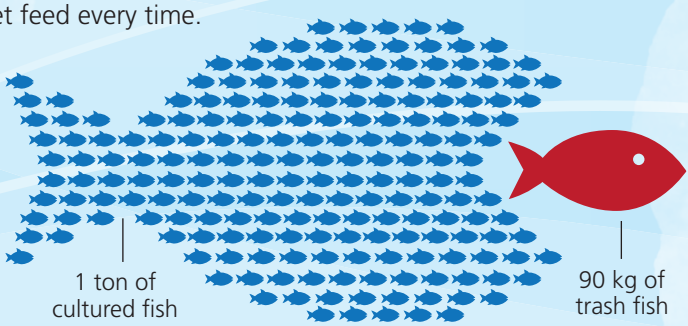
4.4 Trash fish is cheaper, isn't it?

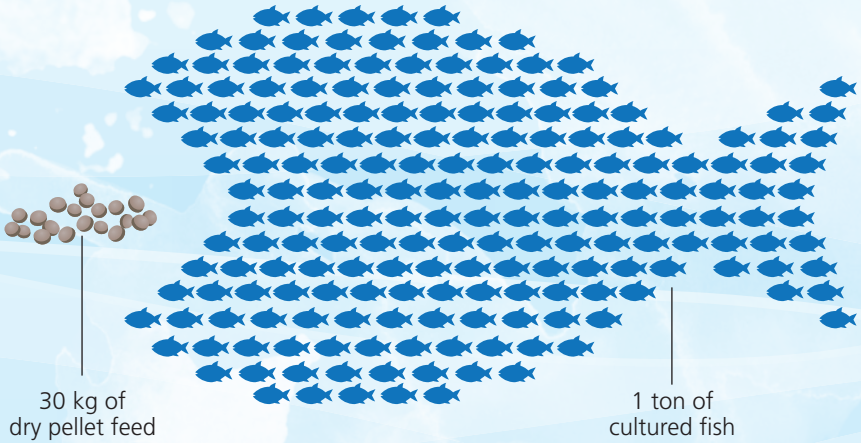
The price of trash fish appears to be cheaper. But due to the high moisture content (about 70%), cultured fish need to consume a large quantity of trash fish to obtain sufficient nutrients. In addition, trash fish may easily carry pathogens, which will cause cultured fish to become sick or even die. In fact, the price of trash fish after dewatering is more or less the same as that of dry pellet feed. From the perspective of feed storage and nutritional value, the cost-effectiveness of feeding with trash fish is far lower than feeding with dry pellet feed.

4.5 Cultured fish consume a large quantity of trash fish every day. If I switch to dry pellet feed, do I need to use much more feed?

Due to the high moisture content of trash fish, cultured fish need to consume a large quantity of trash fish to obtain sufficient nutrients. A ton of cultured fish (about 17 piculs) should be fed with about 90 kg (150 catties) of trash fish every time.

Dry pellet feed has a low moisture content and can be compounded with the nutrients required. Cultured fish only need to consume a small quantity of dry pellet feed to obtain sufficient nutrients. In general, a ton of cultured fish should only be fed with about 30 kg (50 catties) of dry pellet feed every time.





4.6 How to evaluate the cost-effectiveness of dry pellet feed?

Although dry pellet feed is sold at a higher price than trash fish, the nutrient contents of these two types of feed are different. It is inappropriate to make a direct comparison between them based on the price alone. To evaluate whether using dry pellet feed is cost-effective, we must consider both the price and the FCR of the feed, i.e. "the ratio of feed weight required to a weight gain by 1 kg in cultured fish."

The lower the FCR, the higher the cost-effectiveness.

Example:

Assuming that the FCR of trash fish is about 10 (i.e. 10 kg of trash fish is needed for the cultured fish to gain weight by 1 kg) and that of dry pellet feed is about 2 (i.e. 2 kg of dry pellet feed is needed for the cultured fish to gain weight by 1 kg) while the price of trash fish is $2 per kg and that of the dry pellet feed is $12 per kg, the costs involved are as follows:

The costs involved for cultered fish to gain weight by 1 kg by feeding them with trash fish and dry pellet feed are $20 and $24 respectively.

It is clear from the aforesaid example that the cost of feeding with dry pellet feed is higher than that of feeding with trash fish by only $4.

Nevertheless, since using dry pellet feed can increase fish farmers' harvest by effectively preventing diseases and reducing fish mortality, the profit gained is more than enough to offset the higher cost. Thus, it is actually more cost-effective to switch to dry pellet feed which appears to be more expensive than continuing to use trash fish as fish feed.

Fish farmers can request the FCR data from suppliers when purchasing dry pellet feed. However, the FCR may be affected by various factors including fish species, water temperature, water quality and stocking density, and so the data provided by suppliers can only be used as a reference. Fish farmers may calculate the FCR of the feed themselves according to the conditions of their fish farms so as to assess the feed cost accurately.

The method of calculation is as follows:

FCR of feed = Total quantity of feed (kg) used during culture/Total net weight (kg) of fish products

= Total quantity of feed (kg) used per day during culture/[Total weight (kg) of fish products at harvest – Total weight of fingerlings (kg)]

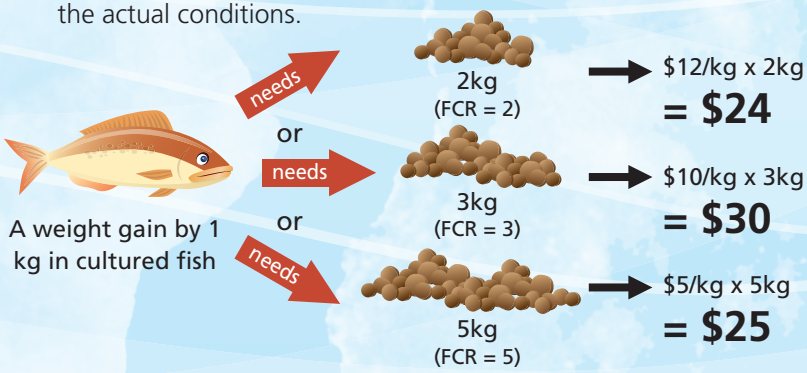
Feed cost for a weight gain by 1 kg in cultured fish = Feed price per kg × **FCR**

Total feed cost = Feed cost for a weight gain by 1 kg in cultured fish × **Total net weight of fish products (kg)**

Fish farmers can keep the Fish Culture Management Records to record the daily feeding quantity and other environmental parameters for calculating the FCR and feed cost in future and monitoring the changes in the aquaculture environment.

4.7 Is using dry pellet feed with a lower unit price more cost-effective?

The FCR may vary with different types of dry pellet feed. Cheaper dry pellet feed may have a lower protein content and a larger quantity of feed may be required. As such, it may not be so cost-effective. Moreover, as the nutritional requirements of different fish species at various growth stages may vary, fish farmers have to make adjustments having regard to the actual conditions.



5 How to Select Suitable Dry Pellet Feed?

Take note of the following factors when selecting dry pellet feed:

- Nutrient contents
  Take note of the nutritional requirements, growth stage, feeding habits and behaviour of the cultured species in order to select a suitable floating or sinking feed with adequate nutrient contents and of an appropriate size.

Take note of the nutritional requirements of the cultured species

- Smell
  Feed specially for carnivorous fish often carries a smell of fresh fish while feed specially for omnivorous fish carries a smell of grass or bran. If the feed has a sour or rancid odour, it indicates that the feed may have become mouldy or oxidised and is not suitable for use.

- Appearance
  Surface of the feed should be smooth. Feed with a very rough surface may reduce the appetite of the cultured fish.

Pay attention to the size and buoyancy of the feed

6 Free Analytical Services on the Composition of Dry Pellet Feed

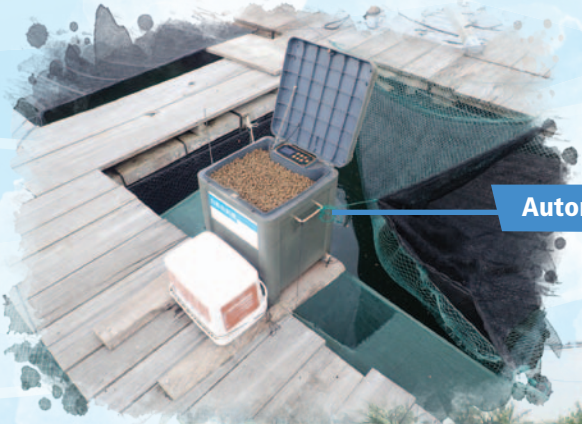
The AFCD regularly collects samples of dry pellet feed available on the market to analyse their composition and monitor their nutrient contents and pollutants (such as heavy metals and malachite green) so as to ensure their quality. Fish farmers may contact the Department should they have any enquiries about the composition of the dry pellet feed they are using.

7 Correct Way of Feeding

Fish farmers should bear in mind the following principles regardless of the type of feed they are using:

- Do not feed the fish too quickly or too much. This does not only waste money but also pollutes the fish farm.
- Observe the response of cultured fish to the intake of feed and feed with an appropriate quantity. A drop in feed consumption may be a sign of fish disease or a warning of deterioration of water quality. Fish farmers should contact a registered veterinary surgeon or the AFCD for assistance.

- Multiple feedings in small quantity throughout the day are preferred.
- An automatic feeding machine may be installed to save manpower if dry pellet feed is used.
- Record the daily feeding quantity to help early detection of whether there is a drop in feed consumption and facilitate calculation of feed cost and the FCR.
- Keep a fish culture record to help early detection of any fish diseases and selection of the appropriate feed and management method so as to control costs.



Automatic feeding machine

Manual feeding

Fish Culture and Feed Records

Fishpond/net cage number : _____ Address : _____

Area and depth of fishpond/net cage : _____

Species of fish : _____ Stocking date : _____

Origin of fry : _____ Stocking quantity : _____

Length/weight of fry : _____

Types of feed : _____

Others : _____

Date	Feeding quantity (catty/kg)	Water quality			Condition of the cultured fish (e.g. fish diseases, no. of dead fish)
		Water temperature (°C)	pH value	Level of dissolved oxygen (ppm)	

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Technical Support

Fish farmers are welcome to contact the AFCD for free information and technical support services:

Aquaculture Technology :
2471 9142 (pond fish) / 2150 7083 (marine fish)

Fish Health and Disease Prevention :
2471 9142 (pond fish) / 2150 7088 (marine fish)

Red Tide and Water Quality Environment :
2150 7124

Antimicrobial Resistance :
3426 2284