Good Aquaculture Practices Series 1

Fish Feed Management

Aquaculture Fisheries Division

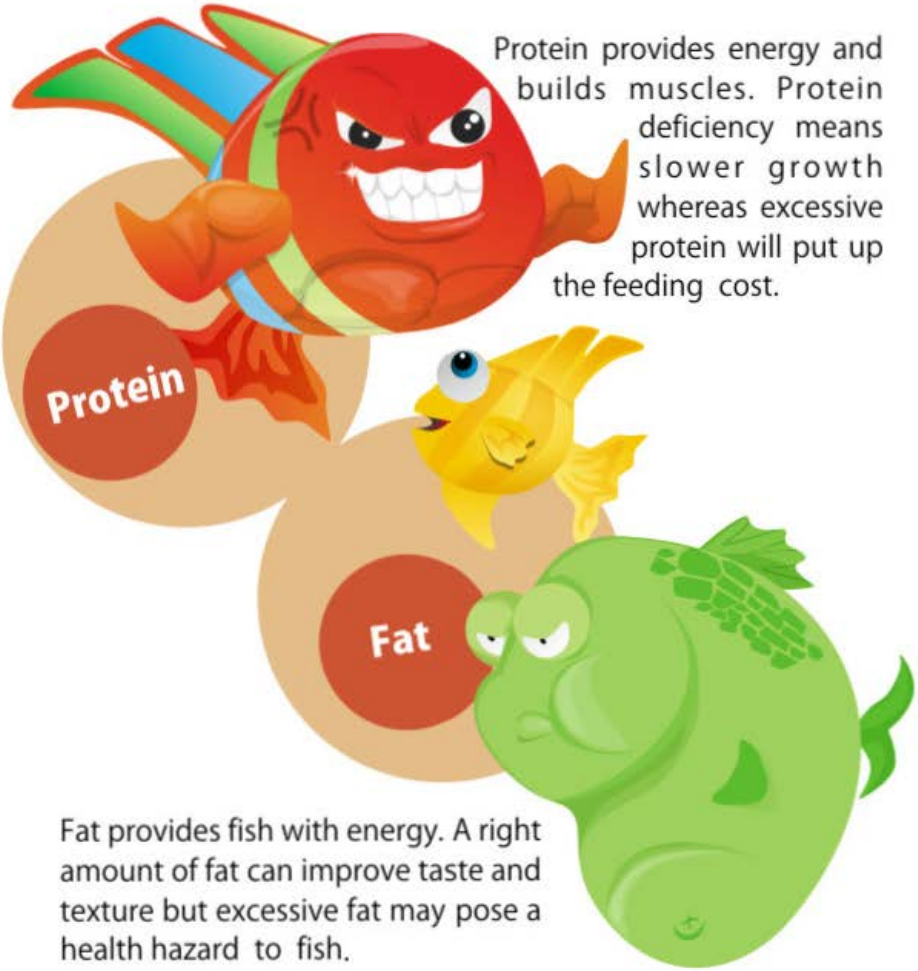
Agriculture, Fisheries and Conservation Department

INTRODUCTION

Fish feed is a major expenditure for fish farmers. Good fish feed management can reduce overall culture cost, improve fish farm environment and ensure healthy growth of fish stock. Fish feed management includes choosing the right feed, using a correct feeding method, calculating the feeding cost and ensuring the cost effectiveness of fish farm.

1 Nutritional requirements of fish

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



Protein provides energy and builds muscles. Protein deficiency means slower growth whereas excessive protein will put up the feeding cost.

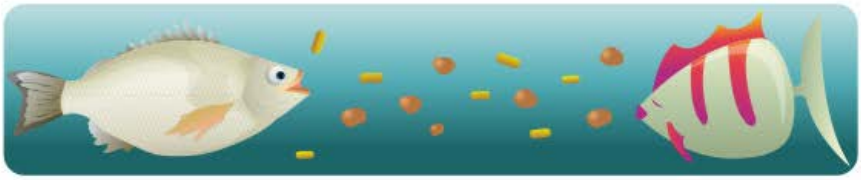
Fat provides fish with energy. A right amount of fat can improve taste and texture but excessive fat may pose a health hazard to fish.

Carbohydrates

Carbohydrates provide energy but most of them are not easily digested by ordinary carnivorous marine species (e.g. grouper, red snapper and mangrove snapper).

Vitamins and minerals

Vitamins and minerals are the essential trace elements that can enhance natural resistance and feed conversion rate (for details of feed conversion rate, see p. 22).



It is noteworthy that nutritional requirements of fish vary with different species, sizes, growth stages and feeding habits. For example carnivorous fish require a higher intake of protein and fat than the omnivorous and herbivorous species, while marine fish require more protein and fat than freshwater fish do. For this reason, fish feed should be specifically chosen to suit different species.

Table 1 : Nutritional requirements of common cultured fish

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

2 Common fish feeds

Fish feeds widely used in Hong Kong include traditional vegetarian feed and trash fish. In recent years pellet feed is also becoming popular.

Vegetarian feed

Wheat bran, rice bran, weed, soy dregs, flour and peanut cakes are suitable for freshwater fish.

Trash fish

Fishing by-catch or small fish is suitable for marine fish.

Pellet feed

There are dry and moist pellets. The former is more popular and the major ingredients are fishmeal made from grinding baked trash fish, fish oil, vitamins and binder. They are extruded and puffed up to produce dry pellets. Moist pellet feed is made up of fishmeal, trash fish, vitamins and binder. The pellets are extruded by a pellet machine. Pellet feed is suitable for both freshwater and marine species.

2.1 Production of dry pellet feed:

Trash fish is first baked and ground into fishmeal. Vitamins, binder and fish oil are then added. The mixture is extruded and puffed up to produce dry pellets.

2.2 Production of moist pellet feed:

Mix 10 catties (6.05kg) of fishmeal with 8 taels (302g) to 1 catty (605g) of binder and 6.5 taels (246g) of vitamin powder, then add shredded or blended trash fish of the same weight and blend into dough. Put the dough in a pellet machine to produce pellets. Deep freeze to -20°C or below.

3 How to choose the right fish feed

With so many varieties of fish feed, how can fish farmers choose one that suits the cultured fish best? One simple way is to compare the nutritional requirements of the species, availability, price, storage method, hygiene and environmental impacts of different feeds and see which one suits the needs of your fish farm best.

3.1 Nutrition

Vegetarian feed and trash fish may not have sufficient nutrients to satisfy the needs of all cultured fish. It may lead to malnutrition which will impair the natural resistance of the cultured fish and heighten the risks of diseases.

Pellet feed can be added with animal or plant protein, fish oil or other fats, vitamin complex and minerals as required by specific fish species. They are highly nutritious and can effectively improve the health of your fish stock.

Fish feed specially formulated for particular species (e.g. grouper, sea perch and grey mullet) are also available on the market.

3.2 Availability

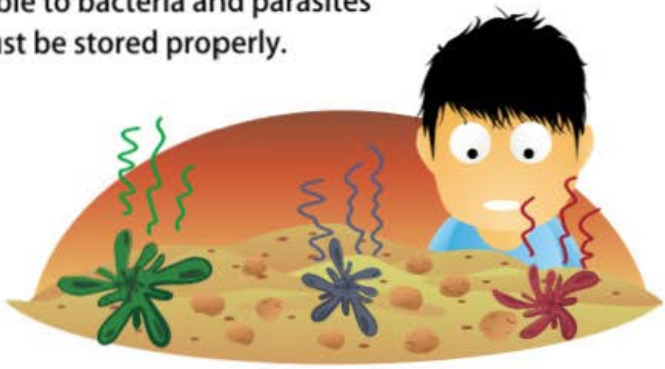
Apart from trash fish, the supply of all other fish feeds is generally stable.

3.3 Prices

Vegetarian fish feed and trash fish are cheaper than pellet feed.

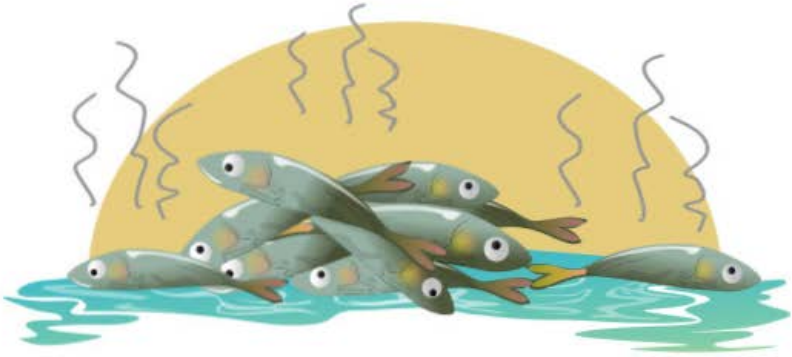
3.4 Hygiene

High moisture fish feed becomes moldy easily. It is vulnerable to bacteria and parasites also and must be stored properly.



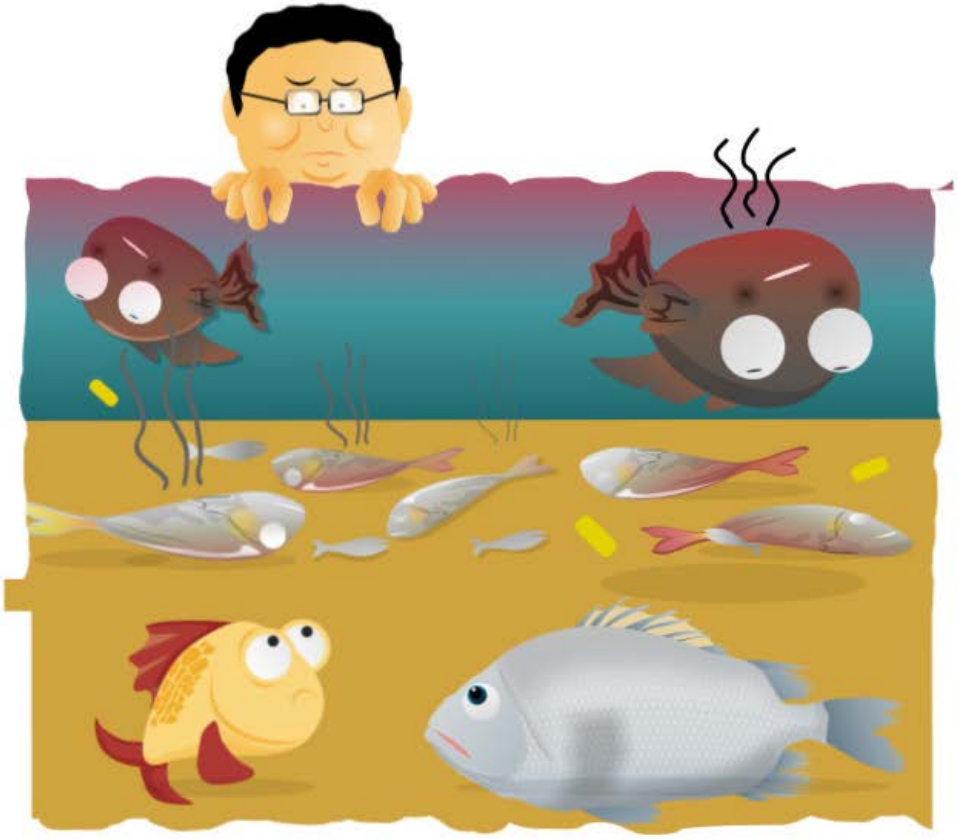
Vegetarian fish feed has a low moisture content and preservation treatment is usually not necessary. As long as it is stored properly there should not be any bacteria or mold problem.

Trash fish is high in moisture (about 70%). If not stored properly at a low temperature, it can get heavily infested with bacteria or parasites. The fat of trash fish oxidises and rots easily. Rotten trash fish may cause disease or even death.



The expansion (dry type) and refrigeration (moist type) process of pellet feed can eliminate most bacteria. Dry pellet feed does not rot easily because it is very low in moisture content (about 10%).

The moisture content of moist pellet feed is about 35% but the trash fish added makes it rot more easily. Refrigeration is therefore essential.



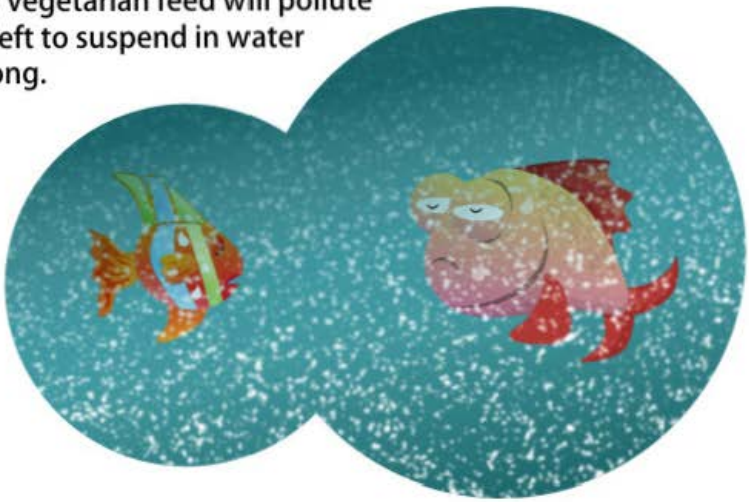
3.5 Storage methods

Low moisture vegetarian feed and dry pellet feed can be kept for two to three months when stored in a covered cool dry place.

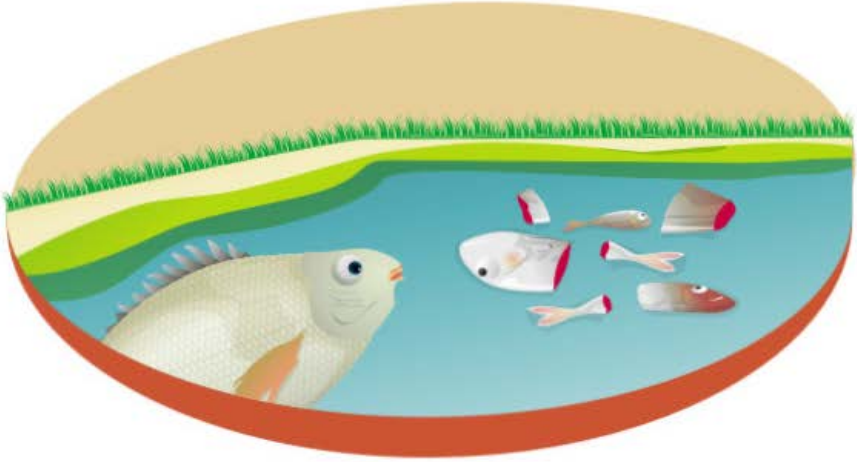
High moisture trash fish and moist pellet feed can be kept for about one week when stored at a low temperature of -20°C. Otherwise they must be used immediately after purchase.

3.6 Environmental impacts

Powdery vegetarian feed will pollute water if left to suspend in water for too long.



Trash fish shreds are irregular in size and have a high loss rate (about 40%). The feed residue deposited on the seabed or pond bottom will cause pollution, resulting in a heightened risk of anoxia and mortality rate.



Pellet feed of different sizes and densities can be made to accommodate the needs of species in various growth stages and with different habits.

By using pellet feed of the appropriate size and density, loss rate and environmental pollution caused by the feed residue can be significantly reduced.

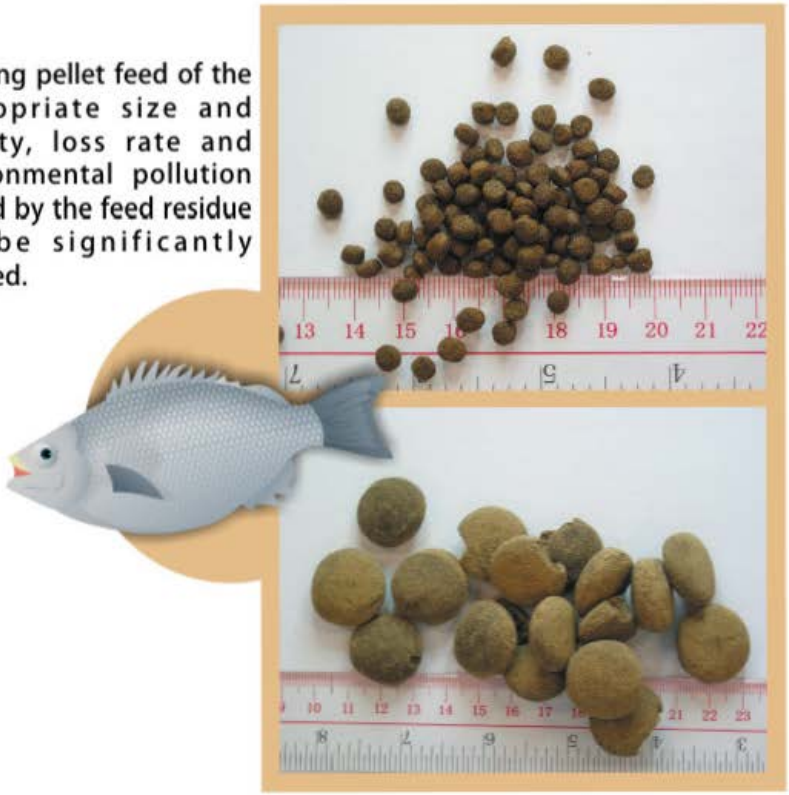


Table 2 : Comparison of different fish feeds

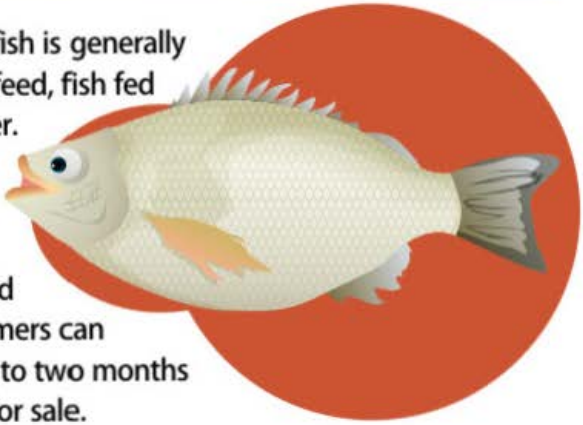
	Pellet Feed		Trash Fish	Vegetarian Fish Feed
	Dry	Moist	By-catch or small fish	Flour, wheat bran, rice bran, weed, soy dregs and peanut cake
Storage	Can be kept for two to three months when stored in a covered cool dry place. ✔ ✔ ✔	Can be kept for about one week when stored at a low temperature of -20°C. Otherwise use immediately after purchase. ✘		Can be kept for two to three months when stored in a covered cool dry place. ✔ ✔ ✔
Hygiene	Expansion process can eliminate most bacteria. Low moisture content (about 10%) can prevent bacterial growth. ✔ ✔ ✔	Refrigeration can eliminate some bacteria. Although low in moisture content (about35%), the additional trash fish makes it rot more easily. Refrigeration is essential. ✔	High moisture content (about 70%) causes infestation of bacteria or parasites. ✘ ✘	No preservative treatment. Due to the low moisture content, the chance of mold or bacterial infestation is low if stored properly. ✔ ✔ ✔
Nutrition	Can be added with animal or plant protein, fish oil or other fats, vitamin complex and minerals required by specific fish species. It is highly nutritious and can effectively improve the health of fish stock. ✔ ✔ ✔		May not have sufficient nutrients to satisfy the needs of all cultured fish. It may lead to malnutrition which will reduce immunity and heighten risks of diseases. ✘ ✘ ✘	
Environmental pollution / impacts	Using pellet feed of appropriate size and density can lower the loss rate and significantly mitigate the environmental pollution caused by the feed residue. ✔ ✔ ✔		Irregular size leads to high loss rate (about 40%) and pollution of seabed and water. ✘ ✘ ✘	Excessive powdery fish feed suspended in water will cause pollution. ✘ ✘

4 Frequently asked questions about dry pellet feed

As shown by the above comparison, dry pellet feed has more advantages over other varieties and it is getting more and more popular in the aquaculture industry in recent years. However many fish farmers are still skeptical about the effectiveness of dry pellet feed. Below are some questions and answers to help clarify concerns.

4.1 Are the cultured fish fed with trash fish more delicious?

Since the fat content of trash fish is generally higher than that of dry pellet feed, fish fed with trash fish may taste better. However dry pellets can be formulated to suit specific nutritional needs and growth stages. To make fish tastier and improve meat quality, fish farmers can begin using high fat feed one to two months before the fish stock is ready for sale.



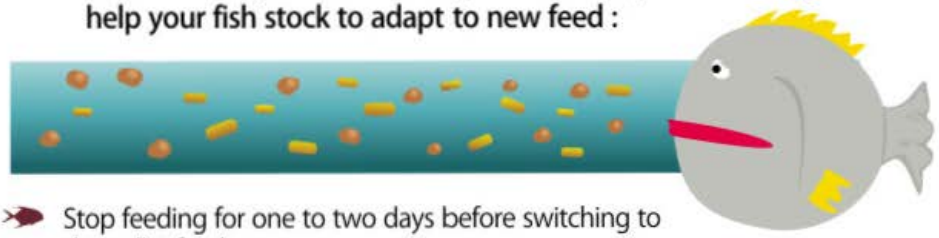
4.2 Do fish fed with pellet feed grow at a slower pace and change colour?

The quality of dry pellet feed was quite varied in early years, and some pellets did slow the growth or cause discoloration. In recent years, the production techniques of dry pellet feed have greatly improved. As long as you choose the right dry pellet feed for the cultured species, your fish will grow faster than those fed with trash fish. The risk of getting sick is also lowered and better harvest is expected.

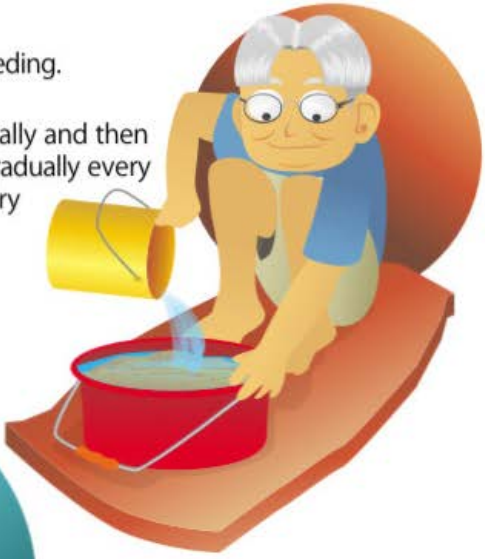
Fish fed with quality pellet feed are healthier.

4.3 Why do cultured fish dislike dry pellet feed?

Dry pellet feed is low in moisture and therefore harder in texture. Fish that are accustomed to trash fish may not be able to adapt immediately so the initial response may not be satisfactory. The following are some tips which may help your fish stock to adapt to new feed :



- Stop feeding for one to two days before switching to dry pellet feed.
- Soak dry pellets in water before feeding.
- Mix the pellets with trash fish initially and then reduce the quantity of trash fish gradually every day. Increase the quantities of dry pellets accordingly.

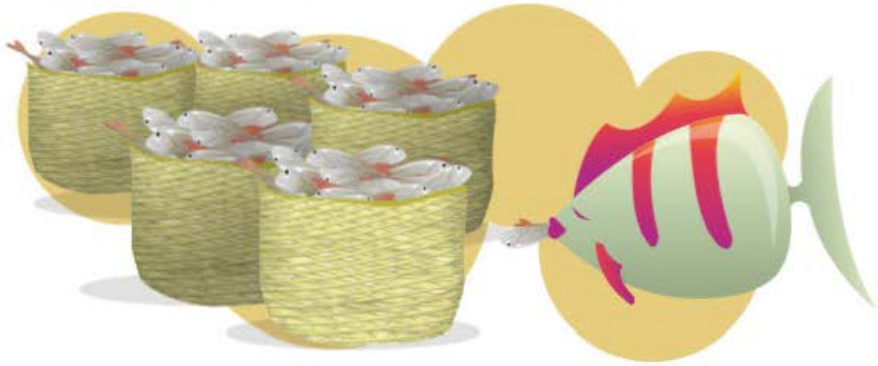


4.4 Is trash fish really cheaper?

Trash fish may seem cheap but the high moisture content (about 75%) means that fish have to consume great quantities to satisfy their nutritional needs. Moreover, this type of feed easily causes infection or even death. In fact, the price of dehydrated trash fish is similar to that of dry pellet feed. Given its poorer hygienic and nutritional value, trash fish is less cost effective.

4.5 Cultured fish consume large quantities of trash fish every day. Will it be a financial burden to switch to dry pellet feed?

Since the moisture content of trash fish is high, cultured fish need to consume large quantities of trash fish for enough nutrients. Every ton (about 17 picul) of cultured fish consume approximately 90kg (150 catties) of trash fish every day.

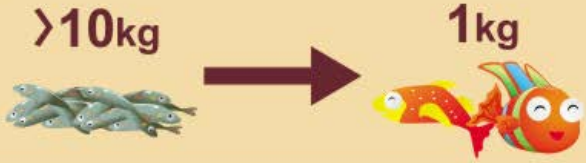


In contrast, the moisture content of dry pellet feed is low. Cultured fish can obtain enough nutrients from a small amount of pellet feed. As a general rule, every ton of cultured fish consume approximately 30kg (50 catties) of pellet feed every day.

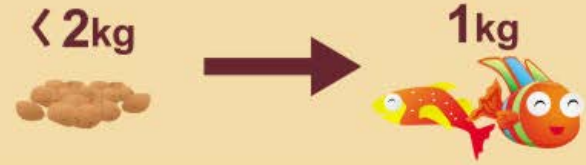
4.6 Dry pellet feed is too costly. Is it not cost effective?

The price of dry pellet feed is higher than that of trash fish and vegetarian fish feed. However, they are different in nutritional values. We should not make direct comparison of prices only. To determine whether dry pellet feed is cost effective, we ought to look at its feed conversion rate (FCR), i.e. how many catties of feed does it take to produce one catty of fish meat.

For example, **trash fish** may be sold for **$2 a kg,** yet its **FCR is about 10**. In other words, you need more than **10kg of trash fish** to culture 1kg of fish.



In contrast, **dry pellet feed** may be sold for **$12 a kg** but the **FCR is about 2**. Accordingly, you can culture 1 kg of fish with only **2kg of pellet feed.**



The costs of using **trash feed and dry pellet feed are $20 and $24 respectively,** making a difference of merely $4.

In addition, using dry pellet feed can enhance fish farmers' harvest and profit by preventing disease and lowering fish mortality. Despite its higher price, dry pellet feed is actually more cost effective than trash fish.

Fish farmers can ask fish feed suppliers about the FCR of the dry pellet feeds before placing an order. However, the FCR may be affected by a variety of factors such as fish species, water temperature, water quality and stocking density. Suppliers' information should only be used as reference. Fish farmers can calculate the correct FCR with the following formulae to assess their feeding cost:

$$\text{FCR of feed} = \frac{\text{Total feed (kg) during culture}}{\text{Total net weight (kg) of fish produce}}$$

$$= \frac{\text{Total amount of daily feed (kg) during culture}}{\text{Total weight of fish produce at harvest - Total weight of fingerlings (kg)}}$$

$$\text{Feeding cost for producing 1kg of adult fish} = \text{fish feed price per kg} \times \text{feed conversion rate}$$

$$\text{Total feeding cost} = \text{feeding cost for producing 1kg of adult fish} \times \text{total adult fish output (kg)}$$

Fish farmers can use the Fish Farm Management Form at Appendix I to record daily feed quantities and other environmental parameters. This information facilitates the calculation of feed conversion rate and feeding cost, as well as the monitoring of changes in the culture environment.

5 How to choose the right dry pellet feed?

Points to note when buying dry pellet feed :

- **Nutrient contents :** Take note of the nutritional requirements, growth stage, feeding habit and behaviour of individual species, then select a pellet feed of suitable nutritional value, pellet size and density.

- **Smell :** Feed for the carnivorous species should have the aroma of fresh fish. Feed for the omnivorous species should have a grassy or wheat bran aroma. Do not use any fish feed that smells sour or rancid. It is a sign of mildew or oxidation.

- **Appearance :** Feed must be smooth. Very coarse pellets are off-putting. They spoil appetite.

6 Free content analysis of dry pellet feed

The Agriculture, Fisheries and Conservation Department (AFCD) regularly collects dry pellet feed from the market for analysis. The aim is to monitor the nutrients and pollutants (e.g. heavy metals and aflatoxin) to ensure feed quality and help fish farmers choose the right pellets. If in doubt about the contents of the dry pellet feed currently in use, fish farmers can seek advice from the Department.

7 The correct way of feeding

Whatever feed you choose, take note of the following :

- Do not feed too quickly or too much. This wastes money and pollutes fish farms.

- Observe how fish respond to feeding and portion the feed appropriately. Low consumption may be a sign of disease or deteriorating water quality.

- It is best to give frequent feeds in small quantities.

- If using dry pellet feed, consider having an automatic feeding machine installed to save manpower.

- Record the daily feed amount to detect any drop in consumption. It also helps the calculation of feeding cost and FCR.

- Keeping farm management record helps fish farmers to control cost and select the right feed and management approach. It helps to detect potential disease outbreaks at an early stage.

Appendix I : Fish Farm Management Form

Fish Culture and Feed Records

Fishpond / net cage number :_____

Address : _____

Fishpond / net cage area and depth : _____

Types of fish:_____ Stocking date :_____

Origin of fry :_____ Stocking Quantities:_____

Length / weight of fry : _____

Types of feed:_____

Others : _____

_____

_____

Date	Feed Quantities (Catty/kg)	Observations			
		Water temperature (°C)	pH	Level of dissolved oxygen (ppm)	Condition of fish (such as disease treatment and no. of dead fish)

Date	Feed Quantities (Catty/kg)	Observations			
		Water temperature (°C)	pH	Level of dissolved oxygen (ppm)	Condition of fish (such as disease treatment and no. of dead fish)

Technical Support

Fish farmers are welcome to telephone the AFCD for free information and technical advice:

General Aquaculture Information : 2471 9142 (pond fish) / 2150 7083 (marine fish)
Fish Health and Disease : 2471 9142 (pond fish) / 2150 7083 (marine fish)
Red Tide and Water Quality : 2150 7124

For further details of fish feed management, contact the Aquaculture Fisheries Division of AFCD on 2471 9142(Pond fish) / 2150 7083(marine fish) or email us at mailbox@afcd.gov.hk

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