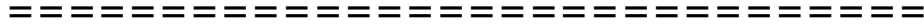
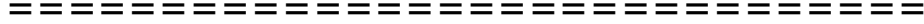


Freshwater Ornamental Fish Culture (Training Manual)



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Thoothukudi - 628 008,
Tamil Nadu, South India

28.05.2021

Online Training Class - Google Platform Link Reference
(28.05.2021)

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DAQ / FC&RI / TNJFU / TN / Dr S Athithan / Google Meet / Online...

Friday, May 28 - 10:00am – 1:00pm

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10 minutes before

Dr S.Athithan TNJFU

**Online Training on
Freshwater Ornamental Fish Farming
28.05.2021 (10 am to 1 pm)**
Dr.S.Athithan, M.F.Sc., ARS., Ph.D
Professor & Head, Dept. Aquaculture
FC&RI, Thoothukudi - 628 008

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Corona SMS
(S)oap
(M)ask
(S)ocial

- (G) ET UP
- (O) PEN YOUR HEART
- (O) PEN YOUR MIND
- (D) EDICATE YOUR WORK TO GOD
- (M) EDITATE
- (O) PTIMIZE YOUR RESOURCES
- (R) EMOVE ALL NEGATIVE THOUGHTS
- (N) EVER UNDER ESTIMATE YOUR POTENTIAL
- (I) SPIRE SOME ONE
- (N) EVER LOSE FAITH
- (G) O OUT WITH JOY & CONFIDENCE



Participants View during Online Training Class By Google Meet (Held on 28.05.2021)

The screenshot displays a Google Meet session with 15 participants. The main grid shows the following participants:

- Premkumar Kathiresan
- Girish Nainwal
- Sudhir Nandhan
- R.Meena
- Mr. Vasu
- Karthikeyan K
- WANSHAPHRANG TIE...
- khandu bhutia
- Thirunavukkarasu Bal...
- Paavana Arvind
- Raja Rajamanickam
- Kirubai Vincent
- salim khadermohideen
- Sudalai Kannu

The right-hand sidebar lists all 15 participants, including the host Dr. S. Athithan TNJ... (You). The bottom control bar includes icons for microphone, video, and other meeting controls. The system tray at the bottom shows the taskbar and system clock (10:27 AM 5/28/2021).

Meeting interface showing a Google Meet session. The browser address bar displays `meet.google.com/pog-ppxs-znx`. The meeting title is `DAQ / FC&RI / TNJFU / TN / Dr S A...`. The interface includes a grid of participants, a control bar at the bottom, and a participant list on the right.

Participants:

- Mr. Vasu
- Premkumar Kathiresan
- khandu bhutia
- Paavana Arvind
- Kirubai Vincent
- Thirunavukkarasu Balasubram...
- R.Meena
- Sudhir Nandhan
- Karthikeyan K
- WANSHPHRANG TIEWSOH
- Girish Nainwal

Control Bar:

- Microphone icon
- End call icon
- Video off icon
- Raise hand icon
- Turn on captions icon
- Present now icon

Participant List (Right Panel):

- Dr S.Athithan TNJ... (You)
- Girish Nainwal
- Karthikeyan K
- khandu bhutia
- Kirubai Vincent
- Mr. Vasu
- Paavana Arvind
- Premkumar Kathiresan

System Tray (Bottom Right):

- 10:11 AM
- 5/28/2021

**List of Registered Participants from Tamil Nadu
Online Training on Freshwater Ornamental Fish Culture
(28.05.2021 / Between 10 and 01 pm)**

1	Mr. S.RAJAMANICKAM CIBA, (ICAR), 75, Santhome high Road, MRC, Nagar, Chennai - 600 028
2	Mr. J.V. Vasantha Kumar 30 Thirumalai Thayar Nagar, Pondicherry
3	S. Sudhir Nandhan 24, 15th Street, KCC Nagar, Bagalur Road, Hosur - 635 109.
4	Mr. Saleem Khader Mohideen 15 B, Senthil Nagar II Street, Chinna Kodungaiyur, Chennai – 600 051
5	Mr.V. Kirubai, 11/130D, Gnanaraj Nagar, Mukuperi, Nazareth, Tuticorin – 628617
6	GOWSALYA PREMKUMAR EF 5, E BLOCK, EDAC APPARTMENTS, MK GARDEN, CHIDAMBARAM 608 001
7	Mr.Karthikeyan K 80, 2nd Main Road, CRR Puram, Manapakkam, Chennai-600125
8	Thirunavukkarasu.B 53A,BHARATHI STREET, AVINASHI - 641 654, TIRUPUR Dt
9	M. Sudalaikannu 3/63/55, Kadai Street, Manji Patti, Nanguneri TK, Tirunelveli - 627 355
10	R Meena 45 B, Poltanpuram 2nd Street, Thoothukudi - 628 003

**List of Registered Participants (Other States of India excluding TN)
Online Training on Freshwater Ornamental Fish Culture
(28.05.2021 / Between 10 and 01 pm)**

=====

1	DR. ABHISHEK MAJHI DULMI, OPPOSITE NAZRUL GIRLS SCHOOL, POST: DULMI NADIHA, DIST PURULIA, OWEST BENGAL PIN - 723102
2	Mr. Arvind NR, 514,7th cross 1st Floor, HAL 3rd Stage, Jeevan Bhimanagar Main Road, Bangalore - 560 075 (SGGSC, BANGALORE)
3	Miss Khandu Doma Bhutia, Central Agricultural University College Of Fisheries Lembucherra, Agartala - 799 210
4	Mr. WANSHAPHRANG TIEWSOH Mawryngkneng, East Khasi Hills, Meghalaya - 793 021
5	Mr. GIRISH CHANDRA NAINWAL Scientist, Krishi Vigyan Kendra, Changlang district, Arunachal Pradesh, PIN - 792121

ORNAMENTAL FISH CULTURE / AN INTRODUCTION

Ornamental fish culture also known as Aquaculture, is the culture of attractive, colorful fishes of peaceful nature in confined aquatic systems. Ornamental fishes are also called as "Living Jewels".

Ornamental fishes, one among the wonderful creatures of nature, provide aesthetic beauty to the environment where it is kept. They are sometimes referred as living jewels because of their colour, shape, behaviour and origin. Keeping of these beautiful, tiny creatures in glass tanks at the living room or guest room as a decorative in home was an ancient practice in countries like China. Aquarium keeping finds its root from 1805 with the first public display aquarium at regents Park in England. In India, hobby of fish keeping is nearly 70 years old; began with British Raj, and is continuing till date. The popularity of aquarium keeping was tremendous making it as the second most important hobby in the world. When domestic electricity became available at turn of the century hobbyists began to keep in aquaria species other than gold fish which required heating and certain other special conditions. By about 1930 it became possible to keep saltwater fish in captivity although high costs and supply distances restricted their acquisition. Because of high mortality and expenses, marine aquaria were not found commonly in private homes before the middle 1960's. With the help of modern technologies hobbyists are able to obtain, display and maintain wide variety of fishes from all over the world with a high degree of success.

Origin of keeping ornamental fishes as pets

The hobby of ornamental fish keeping as pets has originated from China during the year 1163. Gold fishes were the first used for hobby which was kept in glass bowls. The first aquarium was set up by Englishman S. H. Ward during the year 1805 in United Kingdom. The first public aquarium in the world was opened in England in 1852, in the Zoological Gardens in Regent's Park, London. The Frenchman Carbonnier was the first ornamental fish breeder succeeded in breeding paradise fish *Macropodus opercularis* (1869-70). In India, the first aquarium called Taraporevala aquarium was built in Mumbai in 1951.

Major countries involved in ornamental fish buying

- USA
- Europe
- Japan

Major suppliers of freshwater ornamental fish

- Singapore
- Thailand
- Hongkong
- Japan
- Malaysia

Major suppliers of gold fish and koi carp:

- Israel
- Japan

Major suppliers of marine ornamental fishes

- Indonesia
- Phillippines
- Sri Lanka

Status of Ornamental Fish Farming in India

India is still in a marginal position just contributing 1% of total ornamental fish trade. An estimate carried out by Marine Products Exports Development Authority of India shows that there are one million ornamental fish hobbyists in India. The internal trade is estimated to be about 3.26 million US \$ and the export trade is about 0.38 million US \$ in India. The annual growth rate of ornamental fish trade is 14 %. A rich diversity of species and favourable climate, cheap labour make India suitable for ornamental fish culture. Tamil Nadu, Kerala and West Bengal are the major states involved in ornamental fish farming. Two categories of ornamental fishes are being marketed from India - exotic and native. The exotic varieties have been marketed domestically and dominate with 99%. Already 288 exotic varieties have been recorded in Indian market.

More than 200 species of these freshwater fish are bred in different part of India. Mostly native ornamental fishes are exported. North eastern

states, West Bengal, Kerala and Tamil Nadu are blessed with highly potential indigenous ornamental fishes. Around 85 % of native fishes are from North eastern states. 90 % of native ornamental species are collected and reared to meet export demand. Presently about 100 native fish species have been earmarked as aquarium fish. Kolkata, Mumbai and Chennai are major exporting centres. About 90 % of India exports go from Kolkata followed by 8% from Mumbai and 2 % from Chennai. Around 4000 peoples involved in this trade including breeding, live food collection, trading and exporting. There are 20 registered exporters.

West Bengal is in the forefront with a share of around 90 % of our export earnings. Around 7000 - 10000 people are engaged as part time breeders of ornamental fishes in West Bengal. The ornamental fish market of Kolkata is locally called as "Hatibagan Haat" and is the largest in the country.

World trade of ornamental fishes

The world trade of ornamental fishes has shown an increase ever since 1980's. India, despite its vast expanse of sea coast and flow of perennial rivers and consequent abundant resources of freshwater and marine ornamentals is still way behind other developing countries in the matter of development of this trade. In fact, the natural resources of India are more varied as compared to those of Sri Lanka, Africa, Singapore, Indonesia and Malaysia. Several freshwater varieties of Indian fishes are well known in the international market. The lagoons and coral reefs of Lakshadweep and Minicoy islands, Andaman and Nicobar islands, Okha-Pintan-Gulf of Kutch complex, coast of Kerala around Cape Comorin, Gulf of Mannar and Palk Bay abound with highly attractive and varied species of ornamental fishes. We could certainly make a good deal of money and enjoy a considerable share in the world trade by supplying marine ornamental fishes and live rocks originating from the vast resources which are the basic material essential in keeping the aquarium environment healthy. Live rocks afford organisms living in it a much longer life span. Poor knowledge on the part of our people about aquaculture and live fish trade could be the principal reason for our backwardness in this field.

Over 2500 species are involved in the global ornamental fish industry, of which over 60% are of freshwater origin. Although relying largely on captive-bred freshwater fishes, the trade also includes significant numbers of fish and invertebrates collected from the wild. It has been estimated that about 30 freshwater fish species dominate the global market, such as live bearers, neon tetra, angel fish, gold fish, zebra danio and discus. The guppy and neon tetra species alone represent more than 25% of the market by volume and more than 14% by value. Marine fish species constitute more than 15% of the market by value, with about 98% collected from the wild while the rest are captive-bred. Although more expensive than and not as easy to maintain as freshwater aquariums, keeping marine fish in aquariums is becoming more popular. Particularly in the USA and Europe, as prices are becoming more affordable, the marine aquarium sector is expanding rapidly. Technical and economic developments have also helped contribute to the popularity of marine aquariums, especially marine reef ecosystem aquaria complete with fish, corals, shellfish, molluscs and plants. The trade at retail level is worth more than US\$10 billion with an average annual growth of over 10%, while the entire industry including plants, accessories, aquarium, feed, and drugs is estimated to be worth more than US\$18-20 billion.

COMMON ORNAMENTAL FISHES

As said India has a great repository of ornamental fishes especially within the North eastern states and the Western Ghats. Most of the tropical ornamental fishes are only about 3-4cm long and can be kept in considerable numbers within a moderate aquarium.

Criteria to be considered while selecting fishes for aquaria

- Attractive look with beautiful colouration
- Peaceful nature and compatibility with other fishes in the aquarium
- Ready acceptability of artificial food
- Adaptability to live in small confinements

The fauna of ornamental fishes can be divided into various groups which can most likely be identified based on simple external characteristics.

India is regarded as the gold mine for ornamental fish traders with more than 100 varieties of indigenous species. Fresh water ornamental fishes can generally be classified into two groups as egg layers and live bearers. Among the egg layers important ornamental fishes are, Gold fish, Barbs, Rasboras, Tetras, Bettas and Gouramis.

Familiar Gold fish, *Carassius auratus*, is well adaptable to aquaria as well as open outdoor cement cisterns. The fish is preferred by most of the hobbyists because of its varying coloration from pure gold to red, orange, black, albino and due to varying sizes and shapes. Besides these, through selective breeding and cross breeding, alterations are made in morphological characteristics like, divided caudal and anal fins of varying sizes, enlargement and protrusion of eyes, presence of pearl like glittering scales, absence of dorsal fins, transparent and dazzling colors etc. Some of them available in the market are fringe tail, lion head, oranda, comet, shubunkin, telescopic eye, veil tail and red carp. Gold fish can grow upto 20cm and starts breeding at 6 cm size onwards.

Barbs are yet another group of importance and are known to have originated from India include rosy barb (*Puntius conchonius*), striped barb (*P. fasciatus*) and aruli barb (*P. arulius*). Danios include giant danio (*Danio aequipinnatus*), pearl danio (*Brachydanio albalineatus*), and zebra danio (*D. rerio*). Zebra danio is easy to breed and rear and considered as ornamental fish of Indian origin.

Tetras are small 3-8 cm long fishes, originated from South America. Common fishes of the group are black widow tetra (*Gymnocorymbus ternetzi*), serpae tetra (*Hyphessobrycon callistus*), rosy tetra (*H. rosaceus*), lemon tetra (*H. pulchripinnis*), flame tetra (*H. flammeus*), neon tetra (*H. innesi*), cardinal tetra (*Cheirodon axelrodi*), glow light tetra (*Hemigrammus erythrozonus*), head and tail light tetra (*H. ocellifer*), and pretty tetra (*H. pulcher*).

Popular Siamese fighting fish (*Betta splendens*) can be seen in varying colors like green, red, blue, albino and with combinations of different colors. It is widely adopted because of the attractive colors and hardy nature. Males

are more preferred because of their bright color and beautifully spread over fins than females. Presence of other males makes them aggressive. Angel fishes also make an important fish for aquarium trade with varieties including black, veil tail, albino and marble. Among gouramies, three spot gourami (*Trichogaster trichopterus*), pearl gourami (*T. leeri*), moon light gourami (*T. microlepis*), snake skin gourami (*T. pectorialis*), dwarf gourami (*Colisa lalia*), giant gourami (*Colisa fasciatus*), chocolate gourami (*Sphaerichthys osphronemoides*) and kissing gourami (*Helostoma temmincki*) are the important ones. Bettas and gouramies are most popular among nest builders, characterized by accessory respiratory organ, thus making species hardier.

The second group of ornamental fishes, the live bearers will give birth to young ones but the number of off spring will be less than those of egg layers. Here development of young ones takes place inside the body of the female fish, and are released after about few weeks. Common live bearers include guppy (*Poecilia reticulata*), black molly (*Poecilia sphenops*), sword tail (*Xiphophorus helleri*), platy (*X. maculatus*) and their variants.

Commercially important ornamental fishes / Exotic species /

Egg layers

Scientific Name	Common Name
<i>Carassius auratus</i>	Goldfish
<i>Cyprinus carpio var koi</i>	Koi carp
<i>Balantiocheilus melanopterus</i>	Bala shark / Silver shark
<i>Labeo bicolor</i>	Red-Tailed black shark
<i>Rasbora heteromorphy</i>	Rasbora, Harlequin Fish
<i>Paracheirodon axelrodi</i>	Cardinal Tetra
<i>Paracheirodon innesi</i>	Neon Tetra
<i>Colisa lalia</i>	Dwarf gourami
<i>Trichogaster trichopterus</i>	Three spot gourami
<i>Helostoma temmincki</i>	Kissing gourami

<i>Betta splendens</i>	Siamese Fighting Fish
<i>Pterophyllum scalare</i>	Angel fish
<i>Symphysodon discus</i>	Discus / Pompadour fish
<i>Astronotus ocellatus</i>	Oscar
<i>Cichlasoma meeki</i>	Firemouth cichlid
<i>Scleropages formosus</i>	Asian arowana

Live bearers

<i>Poecilia reticulata</i>	Guppy
<i>Poecillia velifera</i>	Sail fin molly
<i>Poecillia sphenops</i>	Marble molly
<i>Xiphophorus helleri</i>	Sword tail
<i>Xiphophorus maculatus</i>	Platy

Indigenous species

Scientific Name	Common Name
<i>Puntius denisonii</i>	Deninson, S barb
<i>Puntius conchonius</i>	Rosy barb
<i>Colisa chune</i>	Honey gourami
<i>Brachydanio rerio</i>	Zebra fish
<i>Chandra nama</i>	Glass fish
<i>Botia lohachata</i>	Reticulated loach
<i>Notopterus notopterus</i>	Black knife fish
<i>Lebeo calbasu</i>	All black shark
<i>Labeo nandina</i>	Pencil gold labeo
<i>Oreochthys cosuatis</i>	Hi fin barb

Advantages of ornamental fish culture in India

- Both fresh and marine ornamental fish are available in India
- Maintaining an ornamental fish farm is very easy
- Breeding can be done throughout the year
- Ornamental fishes have a thriving domestic and international market
- Ornamental fishes are generally more hardy
- Being a tropical country, ornamental fish culture is economically viable.
- Fishes can grow and attain maturity very fast.
- Unlike shrimp farming, ornamental fish culture requires only small area
- Ornamental fish farming is a very profitable venture which requires less investment

Benefits of ornamental fish keeping as a hobby

- Ornamental fish hobby gives pleasure to young and old people.
- Relaxation to the mind.
- Keep blood pressure at normal level and therefore heart related diseases could be prevented.
- Increases life span.
- Children could acquire new knowledge and skills, by counting the number of fishes in an aquarium they get mathematical knowledge and by observing the behaviour, colour and fin shape of fishes they get scientific knowledge.
- Children could develop sense of attachment with nature.
- Ornamental fish keeping is easy over other pets as they don't make noise and also tank cleaning once in a while is enough.
- Ornamental fish like Arowana is believed to bring good luck, wealth and prosperity.
- Ornamental fish keeping can make hobbyists to start their own farms in due course of time thus creating self employment opportunities

AQUARIUM FABRICATION AND MAINTENANCE

An aquarium is a container which displays the aquatic organisms in a simulated natural environment by introducing aquatic plants, rocks, gravels, artificial decorative etc. and maintaining physio-chemical and biological parameters therein with the aid of equipments controlling aeration, water movement, temperature, suspended organic matter, illumination *etc.* besides feeding. An aquarium is a miniature form of an ecosystem which adds to the beauty of our home. This natural “living jewels” makes our living room more attractive and reduce the tensions experienced by the family members or the visitors. The major advantage of aquarium keeping is the low expenditure incurred when compared to other pets.

Ideal site for setting of the aquarium

For setting the aquarium, one must find a stand on which the aquarium can rest so that it is at eye, level. In living and study rooms, a small low table can also be used for the purpose. In all cases, one must take into account the weight of the aquarium and be sure that the table or stand on which it is going to be kept, is strong enough to prevent the aquarium from wobbling every time there is slight push or jerk. Interior decorators and architects make increasing use of fish aquaria as integral part of the design of a room. It is fit into the decor of the house in several ways viz.

- i) Built into a wall, thereby giving an effect of an animated picture
- ii) As a room divider
- iii) Built into a book-case
- iv) For making aquarium-cum-indoor garden
- v) In kitchen cabinetery

Aquarium tank should not be located at a place where it faces direct or excess sunlight as too much of sunlight cause overheating and promote excessive algal growth in the aquarium tank. Once a suitable place is selected, it is ensured that the supporting place has plain and even surface. Uneven surface produces stress on glass and may prove disastrous when aquarium is filled with water. The problem could be overcome by spreading 1

cm thick sheet of thermocol beneath the tank which will act as a cushion to the supporting surface.

The aquarium tank must be checked for any leak before final installation. The leak may be repaired by applying aquarium quality silicon rubber sealant. A tank, once filled, should not be moved as it may spring a leak. Considering the safety and reliability of aquarium tank one should remember the following factors.

1. Aesthetic beauty
2. Size and shape of the tank
3. The volume of water

Table: Size of the tank and required thickness of the glass

Tank size in feet (L x B x H)	Thickness in mm
2x1x2	4
3x1x2	6
4x1x2	8
3x2x2	10
4x2x2	10
5x2x2	12
6x2x2	12
7x2x2	12

*Additional care - There is no additional cross belt in the upper portion of the tank up to a size of 3 x 1 x 2. The tanks above 3 x 1 x 2 size and up to 4 x 2 x 2 size requires additional cross belt on the upper side. Above 4 x 2 x 2 size needs beading and cross link with a size of two inch. Recently, imported modular tanks of various sizes are available in the market

Fabrication of the tank

Two to three days of practical experience will be enough for studying the art of aquarium tank fabrication. Things like good quality glass, gum, glass cutter and silicone sealant can be purchased from glass merchants. Keeping in mind the preferred size of aquarium, size of glass can be ordered. When making the order, take care about the side glass (width wise glass), deduct two times thickness of selected glass from the width of base glass. Before starting to make the tank all the equipment's should be available in the

room including newspaper, Adhesive tapes, sharp knife or a razor blade, scale, scissors etc.

Place the base glass on a leveled floor (/on newspaper) after pasting sealant near to the edges for fixing the other side glass. Then, paste sealant along two sides of lengthy glass and fix above the base glass. Later paste sealant on one edge of side glasses and fix it in the corner of lengthy glass. Finally attach the lengthy glass to the previous one. After finishing the mould, firmly tie a string covering four sides of the tank for avoid sliding the glass while pasting sealant in the corners. One can also buy ready-made aquarium tanks from shops along with the accessories.

Height of the tank

The aquarium tank should always be kept at height of 2.5 feet for viewing from standing and sitting positions in a living room.

Hood

The tank is covered with beautiful roofs made up of plywood or any other wood. The roof is provided with feeding facility and the facility to attach suitable lighting. The tank must be placed not far away from the window, (but not close to the window) which helps to allow some natural light into the aquarium and to promote the growth of plants inside the tank. Even though as said earlier, keeping the tank near to the window invite excess algal growth, which will destroy the beauty of the tank. For easy operation and safety providing electrical plug points near to the tank is ideal.

Table: Aquarium Accessories

Items	Units
Aquarium tank	1
Aquarium hood	1
Aerator	1
Air tube	2m
Air regulator	2
Air stone	2
T-joint and I-joint	2
Florescent light with fittings	2
Thermocol sheet	(suitable size) 1
River sand (3 to 4mm)	enough quantity
Rocks and drift wood	enough quantity

Aquarium plant	enough quantity
Thermometer	1
Heater with thermostat	1
Power filter	1
Hand net	1
Filter bed	1
Magnetic cleaner	1

*Generally these accessories would be enough for, but accessories can change according to ones aesthetic sense.

LIGHTING ARRANGEMENT

Proper illumination is important for healthy functioning of a home aquarium. Apart from providing visual display of ornamental fishes to their best effect, it also stimulates growth of fishes and plants. As a thumb rule, 40 watts of tungsten light or 10 watts of fluorescent tube work ideal for every square foot of water surface. Lighting for 10 to 15 hours a day is considered enough. Fluorescent tube lights are preferred over tungsten bulbs as they have a longer life, less heating effect and low running cost. Nowadays, specially designed glow lux' tube lights are available which give attractive illumination, enhance pigmentation glow in fishes and provide a good balance between infrared and ultra-violet light. The ultra-violet light provides energy to plants for producing chlorophyll and gives better shape to the plants. The infra-red light, on the other hand, is particularly important for photosynthesis. Lights should be placed on the front side of the aquarium as this helps in displaying fishes to their best effect.

HEATING ARRANGEMENT

The ornamental fishes kept as pets in home aquarium come from different tropical countries and are accustomed to live at 22 to 30°C. In places along the coast-line the climate remains quite conducive, there being not much abrupt difference between the temperatures at day and night. However, it would be better to take measures to heat the water in winter, especially at night. Heating is most commonly done by using immersion heaters with adjustable thermostat.

AERATION

During summer months, the water in the aquarium will have to be cooled down to at least 29°C. This is best done by having an aerator (air pump). Connected to a diffuser by a plastic or rubber tube, the aerator forces a stream of air bubbles into the water. The diffuser, which may be a block of pumice stone, breaks up the air bubbles to finer size. The diffuser should be kept just above the bottom of the tank so that a circulation of the water is attained by the bubbles rising up. The aerator should be kept at a level higher than the water level of the aquarium; otherwise water will creep into it when switched off. Besides lowering the temperature, the aerator also helps in increasing the dissolved oxygen content in the water.

FILTERS

Harmful substances like ammonia and nitrites produced mainly through fish metabolites, keep on accumulating in the aquarium. They may exceed the lethal limits and eventually poison the fish. For maintaining a stable and healthy environment in the aquarium, these harmful substances are removed using filters. Various types of filters are available such as under-gravel filter, foam filter, power filter, etc.

Under-gravel filter is the most popular among the aquarists because it is simple, inexpensive, occupies less space and is easy to install. It consists of a hard plastic perforated plate with air-lift pump tube. When air is injected into the air-lift tube, the water is lifted upwards, flows through the gravel below the filter plate and finally filtered clean water is lifted back into the main body of the tank.

Gravel size is an important factor in mechanical trapping of suspended particles. Dark coloured coarse sand of 3 to 5 mm size and 5 to 7 cm thickness above the filter-plate works ideally for filtration. It is important to clean the gravel every month to remove excess detritus matter by vacuum Siphoning. Bacteria help in purification of water. When ammonia loaded water is passed through the gravel bed, it is subjected to the action of aerobic nitrifying bacteria that oxidizes toxic ammonia into nitrite by *Nitrosomonas*

bacteria which get further oxidized by Nitrobacter groups into nitrate which is less toxic to the fish and finally gets absorbed by the plants.

Foam filter is a simple cylindrical plastic box with some holes, both in the base and the top cover. The box contains a thick layer of foam and an air-lift pump tube. When air is passed, the lift pump draws the water passing through the foam, trapping all the suspended particles and the nitrifying bacteria colonizing in foam break down fish waste and un-utilized food. The filter is simple, easy to install and maintain. When foam gets dirty, it is rinsed in clean water and again placed in the plastic box. Foam filters work well for small and medium sized aquaria only in bigger ones they are not so effective. Power filters are generally used in large aquaria which are heavily stocked and require high turnover of water. It can be fitted inside or outside the tank. A high power water pump pushes the aquarium water through a container with one or more layers of filter media and performs both biological and mechanical filtration. No air pump is required for such types of filters. The filtering material is often a foam or wool and needs regular cleaning.

DECORATIVE TOYS

A number of decorative toys are available for making the aquarium more attractive. They include plastic bubblers in the guise of mermaid, underwater diver, oyster shells, angler, human skull, tortoise, frog etc. Artificial rocks, logs, roots and plants are also available. Plastic plants should be of good quality. Ordinary plastic plants may release toxic chemicals even though plastic plants have advantage over the natural plants as fish cannot eat them. These plants are more durable and do not need regular illumination. But when selecting the toys for aesthetic purpose care must be taken as they should be devoid of sharp ends and non-toxic to fishes. The presence of sharp ends makes the animal prone to injury and more liable to occurrence of disease.

PUTTING THE BASE OF SAND OR GRAVELS

Putting a layer of sand or gravels at the bottom of the aquarium tank helps in creating a simulated natural environment. It facilitates fixing of aquarium plants and supports their growth. A medium sized (2 to 3 cm) sand

or gravel is ideal for the purpose. Adequate quantity of sand or gravel is needed to cover about 5 to 6 cm height at the bottom. This provides required depth to hold the plants as also to facilitate aquarium landscaping. The sand or gravels should be so spread that it slopes down from back to front.

PLANTING

Although Fishes can be kept in a plant less tank but usually tanks are planted. Plants have a three-fold effect viz. they serve a decorative purpose, they provide shelter and a sense of security to the fish and during day time, they absorb the injurious gas (carbon dioxide) given off by the fish in breathing and produce oxygen which can be utilized by the fish. Before planting, plants should be disinfected so as to kill harmful germs, parasites, insects and other enemies of fish. This is done by dipping them in 0.1 % potassium permanganate solution for 20 minutes and then thoroughly washed in running water.

Decoration of aquarium tank with plants is an art that can be practiced with imagination, experience and availability of plants. *Vallisneria* and *Sagittaria* are two of the commonest aquarium plants. They have the appearance of grass (hence called eel or tape grass) and are ideal for background. Bushy plants like *Ludwigia* and *Ceratophyllum* should be used to fill up the corners. *Echinodorus* (Amazon sword plant) is a perfect centre piece while small plants viz. Marigrass etc. are used to decorate the front portion.

In addition to plants, stones can also be used to beautify the aquarium. Sharp edged stones, shells and corals should be avoided as these might injure fishes. The shells and corals also leach out into the water and turn it alkaline. Arches made of stones offer good shelter to fishes.

Setting of aquarium

Place the aquarium tank on an even, preferably on one inch thickness thermocol sheet. After placing tank carefully insert under water gravel filter plate into the tank along with air lift pump. Then spread one to two cm manured mixture above the filter, above the mixture spread through washed river sand slopping towards front side. Modulated rocks and drift woods are

firmly fixed in the land scape position. Air stones can be placed behind rocks for good visual effect. Decorate with aquarium plants depending upon your imagination. Planting can be done from this point onwards as stated earlier. While planting the long rooted species, assure that the roots are not damaged. Bushy plants should be tied with a stone to fix them in position. Once the planting is over, the aquarium tank is filled with water without tilting the plants and other settings. Then cover the tank with the lighted hood.

Water filling

Water constitutes the immediate environment for the fishes. Aquarium should be filled with clear potable water. If tap water is chlorinated, it has to be aerated overnight before adding to aquarium. Pouring water directly will cause stirring of the sand and gravel and make the water murky. To avoid this, a shallow pot should be kept on the sand and the water gently poured into this. It will overflow gently over the brim and fill the tank without disturbing the sand.

Tank conditioning

Air pump and other electrical fittings (power head, filter, heater etc) are switched on and allow running continuously for three to five days. During this time water will be cleared and the plants roots will take their position. Flow rate should be adjusted to 18 to 20 times per day for proper functioning of bio filter and the consequent removal of ammonia with the help of nitrifiers. If any plant gets uprooted or requires any change, it should be done before introducing the fish. After having done all these, final effect is clear and can make needful changes accordingly.

Introducing the fishes

After conditioning, the aquarium is ready to receive fishes. The desirable species of ornamental fishes in required numbers are purchased from the market. Fishes that are healthy, swimming upright and move actively with well-defined color patterns on them should be selected. Fishes with deformed bodies, broken fins, white spots or open wounds on the body, showing ungraceful movement should be avoided. It is always better to quarantine newly acquired fishes for a period ranging from one to three days,

disinfect them by giving a dip treatment in a mild solution of potassium permanganate or methylene blue to ensure that they are free from disease or parasitic infection. When purchasing fishes it is essential to make sure that they come from reliable source and are free from disease. Keep the bags containing fishes in the aquarium tank for an hour to acclimatize. After half an hour gradually acclimatize the fish by adding tank water into the fish bag for better survival of fish in the tanks. Stocking density can be adjusted as 75 cm² space for a 2.5 cm fish.

Regular maintenance

A few minutes of watching every day for any noticeable change in the aquarium water, plants or fishes will give you the idea about its proper upkeep. For regular maintenance of home aquarium, it is better to have a check-list prepared and see that they are scrupulously attended to. The more important points to be looked into are:

- Regular water change (20 to 30% every two to four weeks).
- Cleaning of algal scum from the glass at periodical interval.
- Removal of dead fishes, if noticed inside the aquarium.
- Raking the surface layer of the substrate and removal of dirt etc. by vacuuming device every week.
- Pruning of excess plant growth, when noticed.
- If aquarium water turns cloudy after one or two months, it indicates the need to change water.
- Water loss caused by evaporation should be made up once a week.

Besides above, some notes of safety should also be kept in mind, viz.

- Never try to move a filled up aquarium, the glass could crack with pressure.
- Always remember that electricity and water could be a deadly combination. Therefore, all electrical fittings should be completely waterproof.
- Always keep the heater/thermostat completely immersed. If they are removed from water while in operation, they may crack.

- Do not locate the aquarium near a door as frequent hangings will stress the fishes. Knocking on the glass is equally undesirable.
- Try to keep atmospheric pollution in the room, such as cigarette smoke etc. to a minimum. The quality of air in the room is almost as important to fishes, as the quality of water, since the two interact.
- When unhealthy fishes are noticed, they should be removed from the tank and treated separately.
- Snails should not be added to aquarium tank; they may carry diseases and eat plants.
- Large fishes should not be kept with small fishes to prevent predation and injury to small fishes.
- Don't use tap water directly. It should be aerated overnight to remove chlorine. Chlorinated water is harmful to fishes.
- Overfeeding of fishes should be avoided at all cost. It spoils the quality of water resulting in death of fishes.

Food and feeding

A variety of artificial feeds in the form of floating pellets, powder granules, flakes, tablets etc. are available. The feeds can be procured and kept in bottles or containers at room temperature. Fishes should be feed with very small quantities of feed one to four times a day. Instead of dropping entire ration of feed at a time, it is better to give a small pinch and wait for a few minutes within which the fishes pick up all the particles. If completely consumed, then another small pinch of feed can be given. Overfeeding makes the water dirty, depletes dissolved oxygen and emits foul smell due to putrefaction. Such conditions cause stress to the fish and make them susceptible to various infectious bacterial diseases. In addition to the artificial feed, the fishes in the aquarium should also be provided with live feed from time to time. Organisms like tubifex worms, daphnia, mosquito larvae etc. serve ideally as food for the aquarium fishes. Earthworm can be collected from garden soil, cut into very small pieces, washed and fed to the fishes. The biggest advantage with the use of live feed is that it does not make the aquarium water dirty and also helps in making up for any nutritional

deficiency. There are a number of food options available for your aquarium fish, and a combination of foods is necessary to provide aquarium fish with the nutrients they need.

BREEDING OF ORNAMENTAL FISHES

The native ornamental fishes which are having high demand are harvested from their natural sources, making the depletion of natural stock. In this context, captive breeding of ornamental fishes become necessary in order to establish a sustainable ornamental industry. In nature, fishes are stimulated to spawn by changes in environmental factors which are difficult to bring in captivity. However, such conditions can be, to some extent, stimulated in the aquaria by the help of some gadgets and providing these specific biological requirements can stimulate spawning in captivity. The various aspects of breeding comprise selecting the breeding pair, conditioning the brood fishes, observing spawning and raising its young. According to the breeding habits of the fish the breeding tank has to be prepared.

Identification of sexes is an important step for the captive breeding. The mature males of egg layers develop 'pale tubercles' or small 'bumps'- like white spots or cysts on the head, gill cover and pectoral fin which make the male rough to touch. They ooze milt when pressure is applied on the belly. The mature female has a 'gravid spot' on the vent, and the belly is comparatively swollen.

After identifying the sexes, the breeding pair has to be selected. It is selected when they start to show the courting behavior, i.e., interest to each other. Healthy, attractive ones can be selected and are brought to conditioning. Conditioning is done in order to ensure their fitness to breeding through feeding with good quality feed, particularly live feed.

Some of the ornamental fishes particularly egg layers have a tendency to eat up their own eggs/ young ones. So, the eggs / fishes should be removed to another after spawning gets over.

Egg saving measures

- A layer of marble chips or pebbles are provided at the bottom, in which the eggs may lie concealed.

- In case of fishes which release adhesive eggs, provide thick bunches of plants or coir ropes in the tank.
- Provision of net in submerged position below the breeders can save the eggs.

BREEDING OF EGG LAYERS

Tropical fishes mostly are egg layers *ie*, fertilization takes place externally with varying degrees of parental care.

Egg scatterers laying non adhesive eggs

Common egg scatterer includes the zebra fish, in which the larger ones are grouped under the genus *Danio* and the smaller ones under *Brachy danio*. The major problem arising with breeding is egg eating behavior of parents after spawning act. As a precautionary measure, aquarium bottoms are loaded with pebbles at 6-8cm level and they should be well fed with live food like smaller zooplankton.

Male:female ratio for the species is 2:1 or 3:1. Female can be introduced one day earlier than males to the breeding tank. Eggs are of smaller size and remain hidden behind pebbles. The hatching time required is 2-3 days under favorable temperature. After the appearance of hatchlings parents should be removed as fast as possible. Hatchlings take two days to absorb yellow yolk sac. After two days, they can be fed with infusoria for 4 days. Subsequently rotifers and smaller zooplankton can be fed for a week, after which they can be provided with powdered formulated feed.

Egg scatterers laying adhesive eggs

Gold fish, *Carassius auratus*, is one among the egg scatterer laying adhesive eggs. At the time of maturity, when secondary sexual characters appear, male and female gold fishes are selected and kept in circular glass tanks or ferro-cement tanks after disinfecting containers with 1ppm solution of potassium permanganate (KMnO₄). Two year old males and three year old females serve ideally as spawners. Sexes can be identified on the basis of following characteristics:

Belly line: With the male, the belly line continues from the lowest point of the belly to the base of the tail in a slight curve. But with the female, the line

is almost circular when viewed from the top. In most cases, however, a female will have a definite lop (bulging) to one side due to unequal size of the egg sac. But this fullness may sometimes be misleading because some males that have accumulated some fat will also appear like females.

Genital orifice: The shape of genital orifice in males is smaller than that of the females and is of a long oval shape while that of the females is round and slightly protruding.

Tubercles: During the mating period, the males develop small white tubercles on body tissues (also referred to as "pearl organ" or "pimples") on its operculum (gill covers) and pectoral fin and sometimes, on other fins as well. The number of dots, it is said, indicates the level of male's passion. Sometimes, these dots spread even to the scales making the body of the male very rough when touched. The phenomenon is called "oi-hoshi" in Japanese language which means "coursing stars".

The male: female ratio for gold fish is 2:1. Water should be mixed preferably with 50 % ground water and 50% filtered pond water for breeding purpose. Containers should be kept in such a place where it can receive some early morning sun shine and no sun light after wards. Provide artificial nests like submerged plants of *Hydrilla*, split plastic ropes with one end tied or burnt to make it blunt and even polythene strips are found suitable. Nests should float close to water surface, and additional nests can be spread on the bottom of spawning tanks for the eggs that sinks down. The water temperature should be maintained between 20 and 30⁰C ideal being 27-28. Generally female lays 2000 - 3000 eggs. Healthy eggs are golden transparent at the beginning and gradually transparent area decreases. Unfertilized eggs remain opaque and continue to remain as such with arrested growth. After spawning the adhesive eggs will be stick on the material provided. This can be taken out from breeding tank and transfer to hatchery tank. Hatching takes place within 3 days and the hatchling will utilize the available yolk initially. Small sized zoo plankton or artemia nauplii or boiled egg yolk can be provided after 2 days of hatching. In the case of egg yolk the mashed particles should be sieved through muslin cloth.

Rasboras, a group of egg depositing, small shoaling fishes, are ideal for a well planted community aquarium. A temperature between 25 and 28°C is optimum for their breeding. Smaller rasboras lays up to 100 nos eggs/ female while larger ones lays up to 250 eggs per female. They require soft, slightly acidic (pH 5.5) water. After conditioning, they are placed in a tank planted with flat leaved plants. Rasboras in general prefer peaceful and quiet environment for breeding and low lighting levels. The male and female brooders are placed together in a breeding tank for a week. If they do not respond then they should be separated and reintroduced again later. Once spawning has occurred, as indicated by the sliminess of the female fish, remove both the parents from the breeding tank. The hatching takes 24-36 hours, and resultant hatchlings become free swimming after 3-5 days. At this stage, the tiny hatchlings should be fed zooplankton, like moina and daphnia. Adult rasboras can feed good quality dried food.

Nest builders are one among the egg layers showing parental care. The most popular amongst these are the bubble nest-builders which include Bettas and Gouramis, popularly referred to as Anabantids. Presence of labyrinthine organ, an accessory respiratory organ is the peculiarity of these groups of fishes. The organ enables the fishes to breathe from air to supplement the oxygen the fish utilizes from water through gill respiration.

The Bettas or the siamese fighting fish, are peaceful when kept with other fishes, but two males in the same tank will fight viciously. Even a mirror kept in front of a male evokes "anger" responds by spreading out the fins, change of color and opening of the gill covers. If a male does not get a breeding response from a female, it will ruthlessly tear her fins and kill her. Siamese fighters are used for gambling in the same way as fighting cocks. As they can breathe air they can be kept even in very small containers with water having pH of 7. The fish gets sexual maturity at about 3 months old but for breeding purposes it is better to for 9-12 month old fish. While selecting the female, select the one as the same size that of the male fish. The tank can be partitioned to two parts with the help of fine net mesh so that in one

portion mature male and in the other mature female can be kept. A water temperature of 27°C is considered good.

As soon as male starts building the nests, partition net can be removed. This is a crucial point as male become aggressive if female didn't accept the male, resulting in fin tearing of female. If such situation arises the female should be removed from the tank before serious injuries and another female can be provided after few days. The fighter fish seems to spawn in the early morning hours resulting up to 15 eggs from a single embrace and this act will be repeated many times to give a final brood of 200-300 eggs.

Gouramies, another anabantid of ornamental importance can also become aggressive in nature and tend to kill a female, if she is not ready to breed. In all gouramies, the pelvic fins are shaped as long thread-like feelers which can be moved in all directions. For describing the breeding of gouramis, a typical example of the blue or three-spot gourami will be enough. The blue gourami is a medium sized fish growing up to 12 cm in length with silver blue body. It dwells at all levels in aquarium and accepts most food. Blue gourami breeds during April to August. During breeding season, mature males develop dark coloration and females show bulging abdomen. While making breeding pair, care must be taken to select a mature female which is ready to spawn. Aquarium tanks of 50 to 80 litre capacity can be used for breeding with the level of water up to 25 cm. One or two pieces of floating plants viz. water hyacinth or beetal leaves may be floated on the water surface. This helps in holding the bubble nest. The tank should not be provided with any bubble aerator. The ideal water condition for breeding is pH 7 to 7.5, temperature 26 to 30°C and hardness 100 to 220 ppm. The pairing of blue gourami is made in the ratio of 1: 1. If the selected male is in the right stage of maturity, it will start making nest within, one or two days. The nest filled with saliva of the fish floats at the surface or under plant leaves and looks just like soap foam. After the bubble nest is ready, breeding takes place and eggs are lodged in the nest. After breeding, the female is removed as the male takes the role of guarding the eggs which remain attached to the floating bubble-nest. Hatching takes place within 24 hours, as soon as the fry begin leaving

the nest, the male is also removed from the tank. After 36 hours, when the fry are at free swimming state, they are provided infusoria as feed , After 6-7 days, the fry starts taking brine shrimp or small moina, At this stage, they should be fed 3 to 4 times a day, The growth of fish is very uneven and often some "shoot fry" develop. The "shoot fry" i.e the bigger ones of the lot, should be separated and reared in different container, Now, they can be stocked in bigger tanks and given a diet of worms and formulated feed.

The well-known angel fish, *Pterophyllum scalareis* also coming under the group nest-builders. There for, providing plants with broad leaves like Amazon sword plant or some tile pieces will be helpful for deposition of eggs. Parents constantly fan and aerate the eggs; detached eggs are quickly picked up in mouth and re-deposited on the leaf. Care must be taken while breeding of angel fish takes place as slight disturbance will scare the fish resulting in eating their own young ones. Covering the tank will give them enough privacy and helps to reduce the risk of eating the eggs by parents.

BREEDING OF LIVE-BEARERS

Live-bearers are the fishes that do not lay eggs but give birth to young. The majority of live-bearers produce small numbers of fry compared to egg layers. This allows the fry to grow to a large size and an advanced stage of development before birth, thus increasing their chances of survival. There are two types of live-bearers. In species referred to as ovoviviparous, the eggs are simply kept in the female's abdomen, where they hatch and are nourished by yolk. In viviparous fishes, on the other hand, the eggs hatch early inside the mother and she has 'placenta-like' contact with the developing young, supplying nourishment directly to the fetus.

Guppies, platies, mollies and swordtails are the commonest examples of live-bearers. Adulthood in live-bearers is reached as early as 6 to 8 weeks after birth in guppies and platies while mollies take double this time to mature. Sexing of live-bearers is usually quite straight forward. In order to fertilize the female, the anal fin of male gets developed into a structure called gonopodium. This is used to insert the packets of sperms into the female fish. Once fertilized, a female can produce several broods from one mating since

she is able to store male's sperm in her body for several months. Breeding is not a problem with most live-bearers. Males are always eager to mate with females. With its fin spread and quivering, a male keeping his body parallel to the female and a little behind her, make a quick thrust with his gonopodium and swim away. In this act, sperms are introduced in the female's body and the eggs are fertilized. Development of baby fish takes place inside female's body and after about four weeks, a brood of 6 to 100, depending on the species and age of the mother, is delivered.

In guppies, the number of babies in a brood may be 6 to 60, mollies upto 100 while a large swordtail may deliver as many as 200 babies. One mating by a male suffices to fertilize 4 to 5 batches of young, taking birth at an interval of about four weeks. The number of babies at each birth, however, decreases. It is rather easy to know when a female is about to give birth by spotting the dark mark, called" gravid spot' located close to the urino-genital aperture. Bulging appearance of female's abdomen can be used as a sign of carrying animal.

Table 3. Breeding table for livebearers

Species	Sexual dimorphism	Size	Optimum water condition for breeding	Gestation period	Young ones per female	Starter diet
Guppy	Male is smaller with more flowing fins and pointed anal fin or gonopodium	Male:2.5-3.5 cm Female:5-6cm	Temp: 20-28°C, Water hardness 50-100 CaCO ₃ /litre	21-35	20-100	Finely powdered dried feed and rotifers
Platy	Male is smaller and slimmer with gonopodium; Colouration Red, gold, blue, black, brown	Male:3-4cm Female:4-5cm	Temp:23-28°C, Water hardness 50-100 CaCO ₃ /litre	28-42	10-100	Finely powdered dried feed and rotifers

Sword tail	Male is smaller and slimmer with gonopodium and sword like projection on caudal fin	Male:6-7cm Female:7-9cm	Temp:23-28°C, Water hardness 50-100 CaCO ₃ / litre	28-42	20-100	Finely powdered dried feed and rotifers
Black molly	Male is smaller and slimmer with gonopodium dorsal fin is flowing and bigger	Male:7-8cm Female:9cm	Temp: 23-28°C, Aquarium salt @ 0.5-1.0g / litre	40-70	30-70	Finely powdered dried feed and rotifers

As the female live-bearers have the habit of eating their own new born young ones, therefore, for breeding, they are required to be kept in special breeding tank. The selected female showing bulging abdomen and "gravid spot' near the vent are kept alone in a spacious tank with a dense thicket of plants at one end. Breeding of live-bearers is also carried out using breeding trap made of plastic box with perforated bottom which is floated or hooked on in aquarium and pregnant females kept in it. Even a large funnel with its stem cut off can serve as a breeding trap. A small net enclosure hooked on to the wall of an aquarium tank can also serve ideally as a breeding trap for live-bearers.

The young ones in mother's belly remain in a folded position. No sooner they are ejected out; babies straighten out and swim away to the shelter of the plants. As the newly laid babies are large enough at birth, they can be fed on micro worms, brine shrimp nauplii etc.

WATER QUALITY MANAGEMENT IN AQUARIUM

Water is the environment in which fish lives so maintaining good water quality is important for the wellbeing of aquarium fish. Water supplied to the aquarium need not be pure and the aquarium materials can make the water contaminated.

Nitrogenous waste products

It is arising from the fishes itself and through the feed we supplied. Ammonia is the dangerous nitrogenous compound and it may sometimes be

associated immediate use of new aquariums. Rapid method to overcome ammonia toxicity is the use of detoxifiers. But ammonia level drops; there can be an increase of nitrite level the fish has to be added after the reduction of nitrite only, as nitrite is also not good for fish. Most common method to avoid the problem of ammonia like compound is the use of filters. Therefore, filter is a must for the proper functioning of aquarium.

Dissolved oxygen

Oxygen is an important compound for the survival of fishes. For ensuring enough dissolved oxygen to the aquaria, an aerator can be provided with the aquarium especially in the case of non-air breathing fishes and community tanks. Aeration also helps to mix the water in the aquarium, ensures uniform temperature and removes carbon dioxide.

Temperature

Rapid change in temperature is a problem occurs when fishes are introduced to a place. Therefore, when introducing a new fish to the tank time should give to acclimatize the change in temperature of water. For this the fish along with the bag can be kept in the aquarium water for some time so that there will be enough time to acclimatize with.

Sound and vibration

This becomes especially important in case of breeding pairs. The fishes are very sensitive and because of different equipment installed in the aquarium and footsteps, opening and closing of doors might fright the fish and hamper them from normal functioning. While selecting the site for installing the aquarium these things has to be kept in mind. Besides machineries, compressors whatever is making unnatural sounds has to be replaced as early as possible from the tank.

Routine cleaning

Routine cleaning of fish holding facility is a must to avoid the buildup of harmful substances in the tank. Ideally 20 % water has to be replaced along with the evaporative loss. Tank can be cleaned by hand; scrapers can be used for removing algae from air stones, valves and from other equipment. The plants should be trimmed regularly and check for any snail infestation.

Points to remember

Tap water is safe for aquarium purpose but it may have chlorine. Chlorine is not good for fish so before filling the aquarium keep the water aerated for few days. This will help to eliminate the chlorine. In emergency situations, dechlorinating agents like sodium thiosulphate can be used for this purpose. Sodium thiosulphate can be purchased from pet shops.

AQUARIUM PLANTS AND THEIR IMPORTANCE

Most fresh water aquariums can be set up with live plants and whenever possible, it is recommended to do so. The vast selection of plants suitable for aquariums is constantly growing along with affordable, effective, support equipment, providing the aquarist with choices for almost any set-up. Some of the benefits of live plants include:

- Supplement filtration – they absorb ammonium, nitrates and phosphates.
- Live Plants produce oxygen and absorb carbon dioxide when the aquarium is illuminated.
- They provide natural shelters for fish, thereby reducing stress and supporting natural behavior.
- Live plants provide the main decorative feature in an aquarium and become a dynamic element as they grow.
- Live Plants compete with algae through the intake of essential nutrients and absorption of light.

When purchasing aquatic plants, there are several important points to consider:

- ✓ Ensure that you are actually purchasing aquatic plants. It is recommended that you consult knowledgeable store staff and/or books.
- ✓ Look for healthy specimens. Avoid plants that are damaged (holes, broken leaves and/or stems) or exhibit yellow or brown leaves. Rooted plants should have clean looking (usually white) healthy root masses (with the exception of bunch plants).
- ✓ Look for proper holding facilities. Plant tanks should be well-lit and kept at approximate tropical aquarium temperatures.

- ✓ Purchase rapid growing plants at the beginning, commonly sold as bunch plants. This will provide maximum competition for algae.
- ✓ Make sure plants stay wet or damp during the trip home, do not allow any part to dry out.

Planting Tips:

- Incorporate groups of plants in your decor. Select a few species with a quantity of each, as opposed to many different species and minor quantities of each.
- Position plants in appropriate positions with respect to species. Plant taller plants to the rear and shorter plants towards the front. Take into consideration lighting requirements when choosing prospective sites for your plants. For example, plants that prefer lower light levels may be planted in the shade of tall plants.
- Always remove devices used to bunch plants together. Any damaged or dead leaves should be removed. Bunch plants should have only the bottom 1 to 2 inches of stem planted.
- Planting should allow for a little space between groups of stems of plants (bunch plants).
- Never bury the crown of a plant. Expose the crown and avoid gravel between stems.
- Remember – plants grow! Be aware of their maximum size and provide the room and correct initial placement to account for this.

Recommended Aquatic Plants

The following species should be readily available at pet stores and are good groups to choose from with respect to their durability, adaptability, and use in tropical aquariums:

- ✚ Various species of *Vallisneria*: Tolerate a wide range of lighting and water conditions, rapid growing, excellent for background.
- ✚ Various species of *Hygrophila*: Prefer bright light, tolerate wide range of water conditions, rapid growing, suitable for mid to rear of aquarium.
- ✚ *Microsorium* (Java Fern): Tolerate wide range of lighting and water conditions, slow growth, can be anchored to driftwood or stones.

- ✚ Various species of *Echinodorus*: Tolerate wide varieties of light and water conditions. Certain species are excellent for feature or center plants (*Echinodorus bleheri*), many species feature broad attractive leaves. The dwarf Amazon sword (*Echinodorus griesebachii*) is an excellent foreground plant.
- ✚ Various species of *Cryptocoryne*: Usually will take some time for adaptation, great for foreground placement, generally will tolerate or prefer low light levels, tolerate a wide variety of water conditions.

Aquarium plant propagation is one of the powerful industries yet to familiarize in India. Basically 3 types of plant propagation methods are there, vegetative propagation, sexual propagation and tissue culture. Vegetative propagation is the most common method, easiest and cheap. Here a part of the plant is used to make the new plant. Sexual propagation is the traditional method in which a new plant is propagated through seed.

ARTIFICIAL FEED FOR ORNAMENTAL FISHES

The main aim of aquaculture operation in a grow-out pond is to produce maximum weight of marketable fish or shrimp from a given volume of water in the shortest time at the least cost. However, in the case of ornamental fishes, it is meant for maintaining good health, enhancing external appearance and improving their reproductive performances. In other words, the cultured species are fed for production purposes, while ornamental fishes for their beauty and general upkeep.

Different types of artificial feeds

Artificial feeds for ornamental fishes can be broadly classified into four major groups.

i) **Dry feed:** The dry feed can be further classified in three sub-groups viz.

1. Pellets
2. Flakes and
3. Freeze - dried feed.

Generally, pellets are given to large size fishes whereas flakes and freeze dried feeds to smaller ones. Flakes are made using scientific formulae so as to make a nutritious feed. Flakes are made to float on the water surface

long enough to facilitate aquarium fishes to feed on. Flakes come in different colors. Freeze-dried feed are kept fresh for long periods. These are available in cubes which adhere to tank glasses. Fishes nibble at it as it dissolves.

ii) **Moist feed:** Generally, moist feeds are prepared daily and fed to fishes. They cannot be kept for longer periods due to their high moisture content (35%) which cause them to rot.

iii) **Semi-solid/Paste feed:** Finer particles of food are required for baby fishes as their mouth size is very small. There for, all the feed ingredients are compounded into a semi-solid mass or paste like mash. This 'can be squeezed a little at a time and fed to babies through feeder.

Making pelleted feed for ornamental fishes

The nutritional requirement for ornamental fishes may be broadly classified into 2 groups, viz.

Group of Fishes	Protein requirement	Lipid requirement	Carbohydrate requirement
Small	40-45%	4-6%	40%
Adult	30-35%	6-8%	50%

Generally attempts are made to fulfil the protein requirement of the feed and the requirement level of other nutrients gets automatically adjusted. The next step after it is to find out the feed ingredients to be incorporated in the diet. Generally, locally available feed ingredients are selected so as to make it cost-effective.

The most commonly available fish feed ingredients and their crude protein levels are

1. Groundnut oilcake - 40%
2. Soybean flour - 45%
3. Rice bran - 10%
4. Maize - 8%

Select any of the two ingredients. Suppose groundnut oilcake and rice bran are fixed @ 25% each. So, protein contributed from both these ingredients would be as follows:

Ingredients	% Inclusion	Protein contribution (%)
Ground nut cake	25	10 (40×25÷100)
Rice bran	25	2.5 (10×25÷100)
Total	50	12.5

Total requirement of Protein (%) is suppose 32%

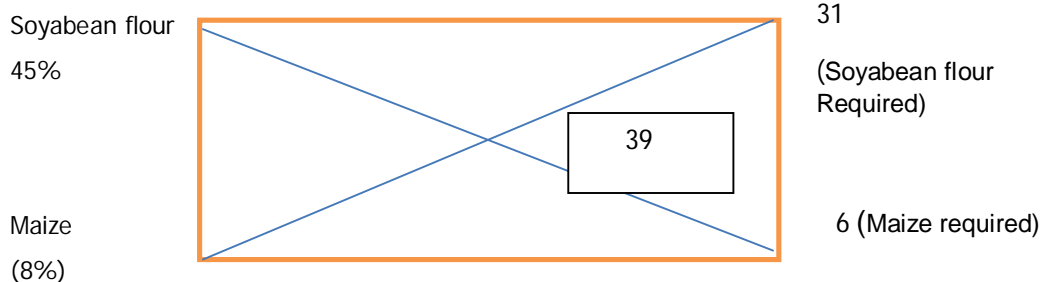
Protein contributed from groundnut oil cake and rice bran (%) 12.5

Remaining 50% by soybean flour + maize contribute 19.50

so, 100% soybean flour+Maize contribute 39

The next step is to find out exact proportion of maize and soybean flour to supplement 19.5% protein. This can be found out by adopting Pearson square method

Example



The value mentioned on left side is the crude protein (CP) content of the ingredients. Whereas, the value mentioned right side is the percent of ingredients required to be incorporated, which are found out by subtracting middle value in cross manner (For getting the required quantity of maize subtract the final protein required i.e. the middle value, from protein content of soya bean flour) from the respective values ignoring the sign.

Thus, the actual amount of ingredients to be used can be worked out as follows:

$$\text{Soyabean flour} = 31$$

$$\frac{31}{31+6} \times 100 = 83.78 = 84\%$$

$$\text{Maize} = 6$$

$$\frac{6}{31+6} \times 100 = 16.21 = 16\%$$

The proportion of soya flour and maize are to be calculated for 50 %
i.e. Soybean flour to be supplemented

$$84 \times 50 \% = 42\%$$

Maize to be supplemented

$$16 \times 50 \% = 8\%$$

Thus the final mixture will be as follows:

Sl.No	Ingredients	Inclusion (%)	Protein contributed (%)
1	Soybean flour	42	18.90
2	Groundnut oilcake	25	10.00
3	Rice bran	25	2.50
4	Maize	8	0.64
Total		100.0	32.04

Vitamin + Mineral + Additives @ 1 %

After having decided the composition of the feed mixture each ingredient is taken and grinded in a mixer. Then mixed ingredients are together. Some additives like colours, binders, enzymes and hormones at desired level are also added to this mixture. Sometimes, the requirement of oil is more which is added directly to the mixture.

Next step is cooking. Water is added @ 30 g for every 100 g feed and dough is prepared. Vitamin mixture is not added to dough as it will get lost during heating. The dough is cooked for 10-15 minutes in a pressure cooker and then cooled. Vitamin mixture is then added following cooling and the dough is then pressed through a hand pelletizer, used for 'semia' making. Care should be taken in selecting the sieve size before pelleting. Sieve of 2 mm dia is generally selected for making pellets for medium to large size fishes. However, these can be broken and fed to smaller fishes as well. After pellet making, drying is required. For this prepared pellets are kept on a polythene sheet and dried under sunlight. Three or four spells of sun-drying is sufficient to reduce the moisture to a minimum so that pellets can be stored for longer duration. Pellet storing part is more vital than pellet making. All the

pellets are kept in a dry and air-tight bottle till use. It is better to keep it at a dark and cool place. Exposure of feed to sunlight would cause loss of vitamins.

Points to be kept in mind while using artificial feed

Giving single large meal to fishes should be avoided. Instead, fishes should be fed 4 to 5 times a day. Amount of food should be given by monitoring daily intake. If major amount of feed is left uneaten, it is indicative of excess feeding or perhaps, feed is not palatable to the fishes. The reason should be found out and steps taken accordingly. Efforts should be made to siphon out unconsumed feed to avoid microbial contamination. Be sure that feeds are not contaminated by mould or fungus before feeding. Feed should be water stable, at least for 1 hour. If with the application of feed aquarium water turns cloudy, it indicates that the feed has low stability. In such a situation, binders like wheat flour, agar, gelatin, sodium alginate etc. are incorporated in the feed mixture. The feed formulation can be manipulated by different ingredients. Selection of ingredients by experiencing with intake of the fishes will be the best feed compared to other ones.

DISEASE IN ORNAMENTAL FISHES

Like all other organisms, ornamental fishes also stand no exception to disease. It may be dietary, parasitic, fungal bacterial or viral. Stress is the main cause for outbreak of most diseases. The stress may be caused due to sudden fluctuations in temperature, poor water quality, inadequate or wrong feeding, poor environmental conditions etc. Therefore, special care should be taken to avoid stress to the fishes in aquarium tanks.

SYMPTOMS OF A SICK FISH

A sick fish will show one or more combinations of the following symptoms:

- ✓ Loss of appetite.
- ✓ Abnormal swimming behavior, showing sudden darting movements.
- ✓ Drooping dorsal and anal fins.
- ✓ Staying stationary at a place while making wobbling movements.
- ✓ Skin showing cloudy patches, white spots or fluffy cotton-like growth.
- ✓ Fins looking frayed and bloody.
- ✓ Excessive mucous secretion.

Timely treatment is most important step in curing a disease and it helps to prevent the spread of disease to other healthy fishes also. Some parasites multiply so fast that even a few hours of delay may make the difference between life and death of the affected fish. Aquarists should, therefore, make it a habit of doing a critical scrutiny of the fish when feeding them and take appropriate remedial measures for the same.

TREATMENT OF DISEASES

Each disease has different symptoms and accordingly, they are required to be treated differently. A broad outline of common diseases of aquarium fishes, their symptoms and suggested treatments for the same are tabulated below:

Disease	Symptom	Treatment
White spot (Caused by small Protozoan, Ichthyophthirius which bores into the skin of Fish)	Pin-head size white spots on body and fins Tendency Of rubbing the body against stones	Increase the water temperature for a few days to 29°C Treat aquarium water with 2% Mercurochrome
Mouth fungus (Columnaris disease)	Fluffy cotton-like growth on the lips Fish swims near the surface of water	Use antibiotics like terramycin or aureomycin @ 132 mg / litre of aquarium water
Velvet (Caused by a Protozoan parasite)	Tiny yellowish spots on fish's body	Place a piece of copper metal in the aquarium and leave it there for a week. Add 30 g of common salt per gallon of water for three days. If necessary, repeat the treatment.
Flukes (attack of leech-like animal on the body or gills of fish)	Fish darts about while swimming and rubs Its body against stones or plants in aquarium	Give dip treatment to fishes in a solution of 50 drops of formaline in 10 litres of water for about five minutes.

		Dip treatment in a solution of one drop of acetic acid in 40 ml of water for half a minute.
Slimy skin (caused by Protozoan parasites)	Bluish-white cloudy patches on the body Fish stays shaking and Quivering near the tank bottom Especially prone are the new born ones of live-bearers	A bath of common salt (2% solution) for 15 to 30 minutes A bath in formaline at 2 ml in 10 litres of water for 30 minutes.
Fin rot and tail rot (bacterial Infection)	Fins become bloody, frayed and are eaten away, leaving only the fin rays	Affected part of the fish may be carefully clipped off and the infected region be swabbed with 3% hydrogen peroxide solution
Dropsy (caused by bad functioning of kidneys)	Body bloats up Scales stand out at an angle to body, like tiles of roof	Disease is Incurable and it is the best to put an end to the misery.
Fish lice (Ecto -parasites of Crustacean origin)	Flashing movements indicating Irritation due to the presence of parasites Rubbing of body against the gravel or sides of the tank	Treatment with a mixture of formalin and malachite green (25 ppm and 0.1 ppm respectively) Mechanical removal of parasites
Anchor worm (Ectoparasite Crustacean origin)	1-2 cm long straw-like structures protruding from the body	Do
Pop-eye (caused due to vigorous aeration or by decaying the tank bottom matter in aquarium tank)	Eye bulges out	Stop aeration for some time Make a partial change of water from tank Apply 1% silver nitrate on popped eyes followed by 1% potassium dichromate.
Crooked body	Deformed body line	No cure

(caused by injury to spine when fish was young or It may be hereditary. Also caused due to faulty diet)	giggling while swimming	
Constipation (caused by faulty diet)	Faeces of the fish are long and stringy and it remains attached to the fish's vent for some time before breaking off. Fish becomes sluggish Belly swells and It may stand on its head	Keep the fish on fast for some time Feeding with Daphnia helps as they act as mild laxatives act as mild laxatives Keep the fish under Epsom salt bath @4 teaspoon salt per gallon of water for 4 hours.

As the saying prevention is better than cure, it is always desirable to keep the fishes in healthy conditions so as to minimize the chances of disease outbreak. Quarantining of newly purchased fishes is a must. Likewise, regular observation of fish while feeding them is also essential. Besides these there are certain golden rules for maintaining good health of fishes which are to be scrupulously followed.

- Avoid over-crowding of fishes in the tank.
- Stocking similar sized fish is always better.
- Over-feeding should be avoided as uneaten food will cause pollution.
- Under-feeding is also not a good practice as this will make the fishes disease-prone.
- No food is nutritionally complete so provide fishes with a combination of artificial and live food.
- Keep the filter apparatus clean and also change the aquarium water partially from time to time.
- Any abrupt change in environment can harm the fish so don't change the water conditions of the aquarium suddenly, it becomes stressful to fishes.
- Always buy healthy, active and brightly coloured fishes.

- Quarantine all new additions before introducing them into your main aquarium.
- Remove any sick fish as soon as possible.

PACKING AND TRANSPORTATION OF ORNAMENTAL FISHES

Ornamental fishes are destined to transportation be it domestic or international. There for to improve the post-harvest / post - shipment survival, modern technologies can be employed. The success of transportation can be ascertained by seeing the death on arrival values (DOA) which can be depend on

- Conditioning of the fishes before packing
- Careful handling practices right from harvesting through shipment.
- Effective packaging techniques
- Stocking density
- Maintenance of low temperature and high humidity through-out storage and transport.
- Replenishment of oxygen and reduction in accumulation of toxic metabolites and controlling of acidity of medium using suitable buffers.
- Reduction in metabolic activity as well as oxygen consumption by the animals.
- Addition of correct doses of permissible anesthetics.

Before transporting to long distances, fish were conditioned (not fed and kept to defecate) in order to get rid of excreta to avoid contamination of water that could lead to stress to the fish. The common way of transportation of ornamental fish involved the use of oxygen, transparent polythene bags, an insulating box, cello tapes, rubber bands, styro-foam and water. The fish in the oxygenated transparent polythene bags are then packed in boxes and can be transported as cargo by road, rail or air.

Steps in Packaging of Ornamental Fishes

A few days before transport, weak and diseased or dead fishes are removed. The active live fishes are then separated into clean water tanks according to species. Subsequently, the fishes are not fed for several days. Very small fish are stopped from feeding 12 to 24 hours before trans-

shipment while for middle sized fish, it is 48 hours and larger fish should not be fed for 3 days before shipment. Thereafter, fish should be carefully transferred into transparent polythene bag with oxygenated water for transport with minimal disturbance.

The packaging process

Ornamental fish are packed in transparent polythene bags (thickness not less than 0.1mm) filled to 1/5 of its volume. The polythene to be chosen for the live fish export should satisfy the needs like,

- High oxygen retaining ability
- Tensile strength
- Tearing strength

The polythene bags are filled with five parts oxygen to one part water. After filling with water and putting fish according to species, the upper part of the polythene bag is compressed to drive out air and then inflated with oxygen. The top of the bag is bent and tied with two or three rubber bands, then placed in styro-foam boxes. The molded styro-foam (thermocol) boxes, seems to have revolutionized packing. Today the most acceptable packing material all over the world is either a complete molded styrofoam box or a carton lined with Styrofoam of minimum 15 mm thickness.

FACTORS TO BE CONSIDERED WHILE TRANSPORTING FISHES

Density

Inside a polythene bag with 20 L of water 2Kg fish can be transported and if the temperature is maintained at 10°C, 5 hours of transportation without additional oxygenation won't make any problem. Further, the density will depend upon the species, container, temperature *etc* of the transportation therefore; trial and error method can be used for species specific data. High density will agitate the fish causing more oxygen utilization, mucus secretion and loss of scale.

Temperature

Temperature is an important parameter that has to be taken care of as it influence activity and oxygen consumption rate. Maintaining the minimum possible temperature is good for the survival. Chipped or crushed ice can be

used for bringing down the temperature but for long distance air freight transfer dry ice can be used. But caution must be taken so that CO₂ should not come into contact with the fish containing medium.

Another thing to taken care of is the change in temperature over transport time insulating the container would be enough for this. After reaching the facility temperature increase or decrease should be done over several hours. In any case drastic change should not be there.

Dissolved gases

In order to get a healthy fish at the end in addition to sufficient dissolved oxygen build up of ammonia and CO₂ should be reduced. The fish can be provided with well aerated water along with sufficient air space.

Anesthetics

During transportation, increased physical activity will bring damages to fish while colliding with each other and with container. Besides their physiological response will be more in active state to the altered conditions of transport. Keeping a lower temperature is good to bring down the physical activity. Another possible way is the use of tranquilizers. The anesthetic using should be

- Effective at low dose level
- Water soluble
- Time of induction and recovery should be low
- Should not have any side effects to fish.

Commonly used tranquilizers include MS222, amobarbital sodium, barbital sodium, hydroxyquinaldine, quinaldine etc.

*Care has to take while selecting the package material for transport as it should be able to withstand journey hazard's like, jerks, drops, compression, impact, vibration, rolling and environmental effects.

MARKETING OF ORNAMENTAL FISHES

Ornamental fishes have got both domestic as well as international market. With a great repository of ornamental fishes, India can make wonders in this industry with proper care, captive breeding techniques and effective marketing strategies. The largest markets for tropical fishes include

USA, Europe and China and about 50% of supplies to these markets are from Asian countries like Singapore, Hong Kong, Japan and Malaysia. India, one of the largest Asian countries with beautiful, potential ornamental candidate species fell far below the line in this industry because of lack of marketing strategies. The internal markets seem to be more attracted towards the exotic fish species rather than the indigenous ones. The private dealers are well established with the breeding techniques of exotic ornamental fishes and the trade is flourishing in a sustainable way.

ECONOMICS

From the view point of exploring the business opportunities in ornamental fisheries, the rearing of ornamental fishes is likely to fetch higher and steady returns than collection of fishes from wild catch due to their better quality and lower risk of mortality during transportation. Also, raising and supplying of ornamental fishes under captive breeding would reduce the pressure on volume of wild catch and therefore, would complement the conservation efforts of native ornamental fish species. The major cost component in initial investment is establishment of basic infrastructure like cemented tank, shed house, balance, water analysis kit, electric pump, air pump, oxygen cylinder, glass aquaria, overhead tank, etc. The major variable cost components were cost of labour, feed, purchase of chemicals, medicines, and charges for electricity and maintenance, cost of brood fish (parent stock) etc.

Capital Investment	
Land Cost (Half Acre)	10,00,000
Building with Roof with cement flour (400 m ²)	4,80,000
Cement Tanks (20 Numbers / Rs 5000 / 4.5 m dia)	1,00,000
Inlet & Outlets	15,000
Water Distribution and Others Joints	10,000
Filtration Facilities	10,000
Electricity Installation	15,000
Instruments & Accessories	
Aerators	15,000
Pumps & Motors	15,000
Glass Tanks	5,000
Plastic Buckets	5,000
Oxygen cylinder & Accessories	10,000
Total	16,80,000

Recurring Expenses	
20 Pairs of Egg Layers	1000
10 pairs of Gold Fish	5000
10 pairs of Fighter Fish	2000
10 pairs of Gourami	2000
Dry Feeds (18 Kg / Year)	36000
Live Feeds	
Medicines / Chemicals / Fertilizers	2000
Electricity Cost	12000
Other Expenses	30000
Labour Charges	60000
Sub Total	1,50,000
Grand Total	18,30,000

Production	
Sale of Egg Layers (60,000 Numbers @ Rs. 3 / fish)	1,80,000
Sale of Gold Fish (40,000 Numbers @ Rs. 6 / fish)	2,40,000
Sale of Fighters & Gourami (25,000 Numbers @ Rs. 5 / fish)	1,25,000
Total Income / Year	5,45,000
Interest on C I (12 %)	2,01,600
Recurring Expenses	1,50,000
Net Income	1,93,400

Back Yard Unit Economics

Capital Investment	
Cement Tanks (20 Numbers @ Rs. 500 / Tank)	10,000
Air Pump (1 Number)	7,000
Pumps & Others	2,500
Glass Tanks (2 Numbers)	500
Total	20,000
Recurring Expenditures	
Brooders Cost	3,000
Feed Cost	5,000
Medicines / Chemicals / Fertilizers	500
Other Miscellaneous Expenses	1,000
Total	9,500

Production	
Sale of Egg Layers (60,000 Numbers @ Rs. 3 / fish)	1,80,000
Sale of Gold Fish (40,000 Numbers @ Rs. 6 / fish)	2,40,000
Sale of Fighters & Gourami (25,000 Numbers @ Rs. 5 / fish)	1,25,000
Total Income / Year	5,45,000
Interest on C I (12 %)	2,01,600
Recurring Expenses	1,50,000
Net Income	1,93,400

Production	
Sale of Egg Layers (20,000 Numbers @ Rs. 2 / fish)	40,000
Sale of Gold Fish (5,000 Numbers @ Rs. 5 / fish)	25,000
Sale of Fighters & Gourami (3,000 Numbers @ Rs. 4 / fish)	12,000
Total Income / Year	77,000
Net Income / Year	47,500

Components of Assistance

- Ornamental fish production – Backyard hatcheries for women SHGs / Fisher women cooperatives/ other house holds
- Medium scale unit for ornamental fish production by the entrepreneurs
- Integrated ornamental fishery units with hatcheries for ornamental fishes
- Setting up of Aquarium fabrication units - women SHGs / Fisher women cooperatives/ others
- Training and demonstration to the beneficiaries of the scheme.

Eligibility criteria

Backyard hatcheries for Ornamental fish production

- Members of women SHGs / fisherwomen cooperatives and any household those who have own house with a minimum area of approximately 200-250 sft vacant land with adequate water facility for setting up of ornamental fish production unit.
- Members of women SHGs/ fisherwomen cooperatives and any household those who have vacant land with a minimum area of approximately 200-250 sft and adequate water facility on lease for a minimum of 7 years period adjacent to their house for setting up of ornamental fish production unit .
- Willing to take up the activity in accordance with the guidelines of NFDB
- Prospective beneficiaries willing to undergo training at the Government sponsored institutions

Medium scale ornamental breeding and rearing unit

- Entrepreneurs having owned a minimum area of approximately 300 mts vacant land with adequate water facility for setting up of ornamental fish production unit.
- Entrepreneurs having taken a minimum area of approximately 300mts vacant land with adequate water facility on lease for minimum period of 7 years for setting up of ornamental fish production unit .
- Willing to take up the activity in accordance with the guidelines of NFDB
- Prospective beneficiaries willing to undergo training at the Government sponsored institutions.

Integrated ornamental fishery units

- State Fisheries Department / Fisheries corporations / Federations/ICAR institutions having own land and water facilities adequate enough to set up the unit. The land along with water facility may be hired on lease basis with a minimum period of 7 years.
- The private entrepreneurs having owned a minimum land area of 1000 sq fts and water facility for setting up of integrated ornamental unit.
- The private entrepreneurs having taken a minimum land area of 1000 sq fts and water facility on lease for a period of 7 years to set up of integrated ornamental unit.
- Willing to take up the activity in accordance with the guidelines of NFDB
- Prospective beneficiaries willing to undergo training at the Government sponsored institutions.

Aquarium fabrication units

- Members of Women SHGs /fisherwomen cooperatives and any individual having owned adequate vacant place for setting up fabrication of aquaria unit as prescribed by the NFDB.
- Members of Women SHGs/ fisherwomen cooperative societies, any individual having taken adequate vacant land on lease for a minimum period of 7 years for setting up fabrication of aquaria unit as prescribed by NFDB.
- Willing to take up the activity in accordance with the guidelines of NFDB
- Prospective beneficiaries willing to undergo training at the Government sponsored institutions

Training of beneficiaries

- Members of Women SHGs /Fisherwomen cooperatives and any individual setting up of ornamental units
- Willing to take up the activity in accordance with the guidelines of NFDB.

Pattern of Assistance

S.No	Name of the Activity/Scheme	Unit Cost	Pattern of Assistance
A	Backyard Hatchery	Rs. 1.50 lakh	40% unit cost as subsidy to members of Women SHGs/ Fisherwomen Cooperative Societies/ Entrepreneurs
B	Medium Scale Unit	Rs 4.00 lakh	40% unit cost as subsidy to all categories of beneficiaries
C	Integrated Ornamental Fishery Units	Rs 15.00 lakh	40% Subsidy to the Government Agencies/ Government Institutions/ Entrepreneur
D	Setting up of Aquarium Fabrication Units	Rs. 1.00 lakh	40% unit cost as subsidy to members of Women SHGs/ Fisherwomen Cooperative Societies. 25% unit cost as subsidy to Entrepreneurs/individual persons.

PROMOTION OF ORNAMENTAL FISHERIES UNDER PMMSY



सत्यमेव जयते

Government of India

Ministry of Fisheries, Animal Husbandry & Dairying

Department of Fisheries

PMMSY – 576 Cr INVESTMENT FOR ORNAMENTAL AND RECREATIONAL FISHERIES

Name of activities	Approx. Unit Cost (Rs. In lakh)	Approximate Physical Quantities	Total Cost (Rs. in Crore)
Development of Ornamental and Recreational Fisheries			
Backyard Ornamental fish Rearing unit (both Marine and Fresh water)	3	1010	30.30
Medium Scale Ornamental fish Rearing Unit (Marine and Freshwater Fish)	8	707	56.56
Integrated Ornamental fish unit (breeding & rearing for freshwater fish)	25	404	101.00
Integrated Ornamental fish unit (breeding and rearing for marine fish)	30	303	90.90
Establishment of Fresh water Ornamental Fish Brood Bank	100	10	10.00
Promotion of Recreational Fisheries	DPR	DPR	25.00
Sub Total (A)			313.76

Name of activities	Approx. Unit Cost (Rs. In lakh)	Approximate Physical Quantities	Total Cost (Rs. in Crore)
Technology infusion and adaptation			
Establishment of large RAS (with 8 tanks of minimum 90 m3/tank capacity 40 ton/crop)	50	50	25
Establishment of Medium RAS (with 6 tank)	25	100	25
Establishment of small RAS	7.5	200	15
Establishment of Backyard mini RAS units	0.5	200	1
Live fish vending Centres	20	110	22
Fish Feed Mills(mini)	15	50	3
Markets and marketing infrastructure			
Construction of fish retail markets including ornamental fish/aquarium markets.	100	20	20
Construction of fish kiosks including kiosks of aquarium/ornamental fish	10	200	20
E-platform for e-trading and e-marketing of ornamental fish	Proposal/DPR based	5	5
Innovative activities, Start-ups etc (10 lakh Gold fish for girl child)	DPR		20
Genetic improvement	DPR		10
Aquapark + Aquarium			100

VALUE ADDITION IN ORNAMENTAL FISH CULTURE

Aquaculture, the culture of living jewels in the confined aquatic system has emerged as the second largest hobby and one of the most favourite commercial businesses in the world. The ever increasing demand for the ornamental fishes has led to the global trade of them where India is trying to make a significant contribution through value addition and popularization of indigenous varieties. The aquarium fishes get high value because of its coloration routine, graceful behaviour, peculiar body morphology, and endemism. But one of the greatest challenges faced by the industry is to replicate the natural colour in the captive environment. So in this regard, the colour enhancement of fish by using eco- friendly feed as well as fabrication of ornamental fish tanks, cultivation of ornamental plants, toys and other decorative for tanks are equally important as the development of breeding techniques to make this in the industry a success.

Value Addition by Color Enhancement

The aesthetic value decides the demand of the fish and therefore the market value of them. Skin coloration is an important factor in this regard. Colour enhancement in fish helps to increase the quality, cost and thus the market value of ornamental fishes. This is possible by administration of pigment enriched eco-friendly feed. The constant intake and adequate level of carotenoids in the feed are essential to optimize the coloration as the biosynthesis of carotenoids is not happens in the fish. Carotenoid pigments give red, orange and yellow coloration. Both synthetic and natural carotenoids can be used for this purpose. Much cheaper sources of carotenoids are plant-based sources which include Alfa-alfa (*Medicago sativa*), Carrot (*Daucus carota*), Marigold flower (*Tagetes erecta*), China rose (*Hibiscus rosasinensis*), etc. In animal-based sources, astaxanthin is the predominant carotenoid rich in crustacean discards. Dried shrimp meal, red crab meal, krill meal are commercially available as fish feed. However high ash content, chitin digestibility issue limit its rate of inclusion in the feed. Some of the microalgal sources are also available commercially like *Hematococcus fluvialis*, *Dunaliella salina*, *Arthrospira maxima*, etc. Examples of commercially available

carotenoids are Lucanthin Pink (contain 10% astaxanthin) and Carophyll Red (contain 10% Anthaxanthin). Along with coloration, carotenoids also have functions like it act like a 1) Vitamin A precursor 2) Antioxidant 3) Growth enhancer, etc. Synthetic carotenoids have some disadvantages like residue problem, deteriorating effect on the environment and they are costly. Further research is needed to make improved feed for better coloration.

Value addition by Transgenesis

The possibility of easier genetic manipulation in fish has led to the success of development of genetically modified organism by transgenesis. It helps to bring out new color variants of ornamental fish to increase the aesthetic value and demand by the market. Even though it has some disadvantages, further improvements can definitely bring novel color variants. Such value-added aquarium fish is patented and trademarked, available in the market in bright red, green, orange-yellow, blue, and purple fluorescent colors. Recently other variants also developed with six attractive fluorescent color combinations, including Star fire red, cosmic blue, electric green, galactic purple, sunburst orange, and moonrise pink. The other goals of transgenesis include the intensification of growth and food conservation, increase tolerance to environmental variables like temperature and salinity and development of disease resistant forms.

Value addition by Painting or Dyeing or Tattooing

Painted fishes are artificially colored fishes to increase the appeal to the customers. The artificial coloring or juicing is possible by injecting the fish with bright fluorescent color dye, dipping the fish into a dye solution, or by feeding the fish with food containing desired dye. This is done to develop exotic colors in fish which is not possible by line breeding. The coloring is not permanent; usually, last for six to nine months. Blueberry or strawberry Oscar which is available in the market is an example of dyed fish. Tattooed fishes with different patterns with different colors are also available in the market. Tattooing is done with a low-intensity laser with a dye. Administration of some of the hormone also showed to increase the coloration in fish.

Conclusion

India is having a great potential in the ornamental fish trade as we have high value indigenous ornamental fish resources. But the trade is largely confined to exotic varieties even if there is a huge market potential is there for native varieties. So the use of native species can be boosted to the global trade along with the improvements in value addition to rectifying the disadvantages of some methods. This will help to increase the market value and demand of fishes thus leads to an established ornamental trade industry in India.

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அன்பார்ந்த மீன்வளச்சுடர் வாசகர்களே...

தங்கள் நண்பர்கள் கையிலும் மீன்வளச்சுடர்
இதழ் தவழ்ந்து பயனளிக்க வேண்டுமா? எடுத்துக்கூறுங்கள்

ஆண்டு சந்தா ரூ. 200

ஆயுள் சந்தா ரூ. 2000

அருகிலுள்ள மீன்வளக்கல்லூரி மற்றும் மீன்வள மையங்கள் மூலமாகவோ, ஆசிரியருக்கு சந்தா தொகையை அனுப்பி மீன்வளச்சுடர் இதழைப் பெற்று கொள்ளலாம். சந்தா அனுப்புவதாக இருந்தால், வங்கி வரைவோலை Director of Extension Education, TNJFU, Nagapattinam என்ற பெயரில் எடுத்து ஆசிரியர், மீன்வளச்சுடர், விரிவாக்கக் கல்வி இயக்ககம், தமிழ்நாடு டாக்டர் ஜெ. ஜெயலலிதா மீன்வளப் பல்கலைக்கழகம், வெட்டாறு நதிக்கரை வளாகம், நாகப்பட்டினம் - 611 002 என்ற முகவரிக்கு அனுப்பி, இதழ்களைப் பெற்றுக் கொள்ளலாம்.

மேலும், தாங்கள் வசிக்கும் ஊர்களிலும் எங்களது பல்கலைக்கழக மையங்கள் அமைந்திருக்கும் முகவரியில் தொடர்பு கொண்டு, மீன்வளச்சுடர் இதழுக்கான சந்தா தொகையினைச் செலுத்தலாம்.

ஆசிரியர், மீன்வளச்சுடர்

மீன்வளச்சுடர்

அக்டோபர் - டிசம்பர் 2013
காலாண்டு மலர்

சிப்பி : 1
முத்து : 4



சிறப்பாசிரியர்
பேராசிரியர் பாஸ்கரன் மணிமாறன்

விலை ரூ. 15

தமிழ்நாடு மீன்வளப் பல்கலைக்கழகம்

Vocational Training Programme	
1 Day	Rs. 300
2 – 3 Days	Rs. 500
1 Week	Rs. 1, 000
Entrepreneur Training Programme	
2 Weeks	Rs. 3,000
Skill Training Programme	
Up to 2 weeks	Rs. 2,000
More than 2 weeks	Rs. 3,000

Name of the training programme
1) Fish Feed Preparation
2) Spirulina Cultivation
3) Liquid Seaweed Fertilizer
4) Quality Control of Aqua Feed
5) Artemia Biomass & Cyst Production
6) Fish Food Organisms
7) Seaweed Farming
8) Crab & Lobster Fattening
9) Fish Culture
10) Shrimp Farming
Date of conduct of the training
Training Fee as Cash / DD / Cheque
Educational Qualification
If employed, Name & Address
Reasons for joining training programme

**Department of Aquaculture
Dr. M.G.R Fisheries College & Research Institute
Tamil Nadu Dr.J.Jayalithaa Fisheries University
Oradiyambulam, Thalainayeru – 614 5712, Nagapattinam District
Training Application Form**

Name of the participant / trainee		
Name of the father / husband / guardian		
Address for communication		
E mail ID		
Mobile Number		
Telephone Number		
Date of Birth		
Age / Sex	Age:	Sex:
Nationality / Religion / Community		
Type of training programme with duration and fee		
Vocational Training Programme		
1 Day		Rs. 300
2 – 3 Days		Rs. 500
1 Week		Rs. 1, 000
Entrepreneur Training Programme		
2 Weeks		Rs. 3,000
Skill Training Programme		
Up to 2 weeks		Rs. 2,000
More than 2 weeks		Rs. 3,000
Name of the training programme		Tick Relevant Training Programme (√)
1) Farm Made Fish Feed Preparation		
2) Spirulina Cultivation		
3) Liquid Seaweed Fertilizer		
4) Quality Control of Aqua Feed		
5) Artemia Biomass & Cyst Production		
6) Fish Food Organisms		
7) Seaweed Farming		
8) Crab & Lobster Fattening		
9) Carp Culture / GIFT Tilapia Culture		
10) Shrimp Farming		
Date of conduct of the training		
Training Fee as Cash / DD / Cheque / Online		
Educational Qualification		
If employed, Name & Address		
Reasons for joining training programme		
<p>Declaration</p> <p>The above information furnished by me is true and correct to the best of my knowledge and belief</p>		
		Signature

Chatting Copy during online Training Class (28.05.2021)

00:10:36.396,00:10:39.396
salim khadermohideen: Programme started or not yet? I have no audio nor video

00:11:00.164,00:11:03.164
Premkumar Kathiresan: not started

00:11:08.051,00:11:11.051
salim khadermohideen: Ok

00:11:21.011,00:11:24.011
Kirubai Vincent: Some problem I think so...

00:11:28.955,00:11:31.955
salim khadermohideen: Good morning to everyone

00:11:43.466,00:11:46.466
Kirubai Vincent: Sir video and audio left

00:11:52.135,00:11:55.135
Kirubai Vincent: Morning

00:12:18.579,00:12:21.579
Girish Nainwal: Good morning Sir

00:12:53.840,00:12:56.840
Girish Nainwal: Audible

00:13:06.442,00:13:09.442
Kirubai Vincent: Salim sir mute your audio

00:14:57.741,00:15:00.741
Girish Nainwal: There is some discussion is going on

00:15:12.059,00:15:15.059
Girish Nainwal: Plz mute

00:18:56.983,00:18:59.983
Raja Rajamanickam: Good morning to all.Iam S.Rajamanickam,Assistant chief technical officer ,ICAR-CIBA,Chennai

00:24:16.481,00:24:19.481
Mr. Vasu: Sir , Feed preparation also included in this training ???

00:24:32.392,00:24:35.392
Mr. Vasu: okk sir

00:25:01.535,00:25:04.535
Raja Rajamanickam: Good morning to Dr.S.Athithan sir

00:25:15.123,00:25:18.123
Thirunavukkarasu Balasubramanian: And how to quarentine fishes sir

00:26:43.411,00:26:46.411
Karthikeyan K: yes Sir

00:26:45.801,00:26:48.801
Premkumar Kathiresan: yes sir

00:26:47.206,00:26:50.206
Girish Nainwal: Yes Sir

00:26:52.138,00:26:55.138
salim khadermohideen: Yes

01:09:28.198,01:09:31.198
Premkumar Kathiresan: yes sir

01:43:37.897,01:43:40.897
Mr. Vasu: culture of worms has been successful sir ????

01:57:49.879,01:57:52.879
salim khadermohideen: No audio

02:46:45.009,02:46:48.009
Karthikeyan K: where to sell the ornamental fishes ..?

02:47:41.119,02:47:44.119
Paavana Arvind: Aquarium cleaning, should only water hange be done only or the whole tank should be cleaned

02:47:54.494,02:47:57.494
Thirunavukkarasu Balasubramanian: Where can we get the medicines which we using in farms to prevent diseses

02:48:00.902,02:48:03.902
Kirubai Vincent: More suitable and good profit breed in our area

02:48:11.941,02:48:14.941
salim khadermohideen: I was not available from 12.30 pm. Can you please send me the presentation between this time

02:48:13.167,02:48:16.167
Kirubai Vincent: Tuticorin

02:48:20.424,02:48:23.424
Raja Rajamanickam: who is to authorize to green certificate for Ornamental fish exports

02:48:34.992,02:48:37.992
Premkumar Kathiresan: dhalphinia culture sample can i get

02:50:12.179,02:50:15.179
Karthikeyan K: should i need to register as farmer in state fisheries department before undertaking ornamental fish farming ?

02:50:17.026,02:50:20.026
Paavana Arvind: How to make biological filter

02:51:07.679,02:51:10.679
WANSHAPHRANG TIEWSOH: thank you sir

02:51:37.861,02:51:40.861

Raja Rajamanickam: what is the strength and weakness of Ornamental culture and exports in india

02:53:36.617,02:53:39.617

Thirunavukkarasu Balasubramanian: For my shop i have purchased fishes from farms but after adding to the stocking tank it will dyes day by day

02:54:14.601,02:54:17.601

Thirunavukkarasu Balasubramanian: Please advise somr suggestions to prevent the fishes from sudden deaths.

02:55:44.652,02:55:47.652

Thirunavukkarasu Balasubramanian: List out scaless fishes please

02:56:26.509,02:56:29.509

Paavana Arvind: How much quantity should fish be fed if it is a 3 inch fish

02:57:16.281,02:57:19.281

Kirubai Vincent: Best suitable breeds for new starting breeding....

02:57:30.628,02:57:33.628

Paavana Arvind: How many days the fish has to be quarantined before transportation

02:57:39.313,02:57:42.313

Thirunavukkarasu Balasubramanian: For scaless fishes can we do salt path to cure the fish deceases

02:59:11.750,02:59:14.750

Paavana Arvind: Are pleco fish good for aquariums

03:00:41.428,03:00:44.428

Karthikeyan K: how to maintain PH value when there is a fluctuation?

03:00:43.981,03:00:46.981

Thirunavukkarasu Balasubramanian: Suggest economical stress relievers for quarantine tetras

03:00:59.172,03:01:02.172

salim khadermohideen: For a new starter how much investment, place needed, for a minimum profit and how much? And what varieties to start in the beginning?

03:01:03.176,03:01:06.176

Paavana Arvind: Is there the next level training in continuation

03:01:22.695,03:01:25.695

Kirubai Vincent: Open cement Farming need shade area or can use open place

03:03:01.416,03:03:04.416

salim khadermohideen: Is there any portal site to get all information

03:03:23.444,03:03:26.444

Thirunavukkarasu Balasubramanian: Please advise stress relieving medicines for fish

03:03:50.690,03:03:53.690

salim khadermohideen: Thank you very much

03:04:15.049,03:04:18.049

Kirubai Vincent: Thank you sir .. Its very useful ..

03:04:50.438,03:04:53.438

Mr. Vasu: Thank you for this Informative Webinar Sir.. i will Mail you my questions.....

03:05:00.417,03:05:03.417

Karthikeyan K: Thanks a lot Sir ...

03:05:17.982,03:05:20.982

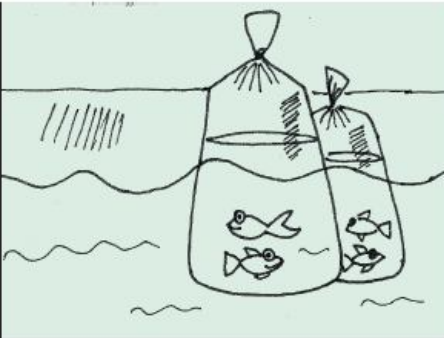
Premkumar Kathiresan: thank you sir

**Answers for the questions asked Under Chat Box
During Online class held on 28.05.2021**

00:25:15.123,00:25:18.123

Thirunavukkarasu Balasubramanian: And how to quarantine fishes sir

**BMP
Quarantine Protocols for
Freshwater Ornamental Fish**



Quarantine helps a producer to supply healthy fish to hobbyists. It would ensure reputation and credibility of the supplier and ultimately the profitability.

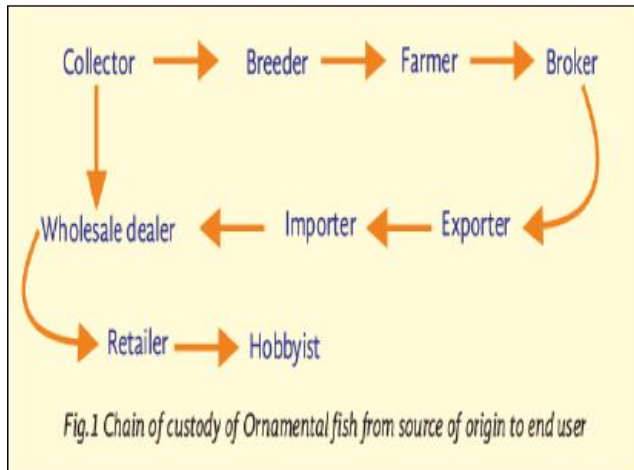
BMP 1

Quarantine facility should be isolated & separated from main production & marketing facility

It is one of the most important prerequisites while setting up a quarantine facility.

It is because of the reason that there are high probabilities that fish which will be kept in quarantine facility is infected.

In case, quarantine facility is located close to production facility, there will be high possibility of disease transfer from quarantine facility to production facility.



- Guiding factors for BMP-1**
- 2.1 The fish holding systems in the quarantine area should be smaller and less extensive than main facility.
 - 2.2 The quarantine tanks should have viewing facility that is adequate to observe fishes for behaviour and signs of pathology, easier to monitor, capture and treat the fish and also remove mortalities.
 - 2.3 The system should be able to comfortably accommodate the largest fish size and numbers you expect to receive. The habitat and hiding places in the tank should be simple in the construction and easy to clean and disinfect and not have any parts that could injure the fish.
 - 2.4 Only properly trained and authorized people should be permitted to enter the area.
 - 2.5 The restricted nature of this area is emphasized by appropriate and well-placed signage.

BMP 2

Precise monitoring & maintaining of water quality at quarantine facility is of prime importance

Water quality at quarantine facility is very important.

A sudden change of water quality during the quarantine process may lead to undesired results.

Guiding factors for BMP-2

- 3.1 Water quality parameters should be both optimum and stable. New fish are always much stressed and it is essential that they be placed in a stable environment while they undergo quarantine and acclimation.
- 3.2 Each quarantine tank should have its own set of equipment (nets, totes, bowls, siphons) and disinfectant baths. It will be desirable to install ultraviolet lights and/or an ozonizer in the incoming water supply line from overhead tanks so to sterilize the water coming to quarantine tanks.
- 3.3 Each tank should have a separate filtration system. A poorly designed or complicated quarantine systems that are difficult to access are generally not well maintained.

BMP 3

Fish should be quarantined only for specific period with practice of "All-in-All-out" methodology

The quarantine period should be time specific.

A period of less duration is considered ineffective whereas a longer period is undesirable as well as uneconomical.

Guiding factors for BMP-3

- 4.1 The duration of quarantining may vary from species to species. Ideally, tropical fish should be quarantined at 22-25°C and cold water fishes at no less than 12-15°C. At lower temperatures, it is best to double the quarantine period.
- 4.2 The period of quarantine could be 21 days for Goldfish, 14 days for gouramys & cichlids and 7 days for other freshwater fin fish. If the fish are brought for breeding purposes the quarantine period may last for 15-30 days depending on the species.
- 4.3 Lights should be kept off for the first 12 to 24 hours.
- 4.4 No new stock of fish should be added to the quarantine tank while an old stock is already being quarantined. Only "All-in-All out" methodology should be adopted. If new fish are added to the quarantine system before the quarantine period is completed, the quarantine period resets to day 0 for that system.
- 4.5 Fish from each supplier should be quarantined in separate systems and not mixed together. In the event that a group of quarantined fish develop disease, this separation will allow you to accurately identify the source of the diseased fish.
- 4.6 At the completion of the quarantine period, all fish in a quarantine system are moved out and the tank and support system housing those fish are disinfected before another new lot of fish is moved into quarantine.

Process of acclimatization

1. Turn off aquarium lights
2. Dim the lights in the room where the new arrivals will be opened. Never open the bag in bright light - severe stress or trauma may result from sudden exposure to bright light
3. Float the sealed plastic bag in the tank for 15 minutes (Fig. A). Never open the bag at this time. This step allows the water in the bag to adjust slowly to the temperature of the tank while maintaining a high level of dissolved oxygen.
4. After floating the sealed bag for 15 minutes, cut open the bag just under knot or rubber band (Fig. B) and roll the top edge of the bag down one inch to create an air pocket within the lip of the bag. This will enable the bag to float on the surface of the water (Fig. C). For heavy pieces bags that will submerge, place the bag in a plastic bowl or specimen container
5. Add 1/4 cup of tank water to the plastic bag (Fig. D).
6. Repeat step 5 every ten minutes until the arrived bag is full.
7. Lift the plastic bag from the tank and discard half the water from the bag (Fig. E).
8. Float the shipping bag in the aquarium again and proceed to add 1/4 cup of tank water to the arrived bag every four minutes until the bag is full.
9. Use a very soft hand net to gently catch the fish from the bag and release them into your tank (Fig. F).
10. Remove the filled plastic bag from the tank and discard the water. Never release water from the newly arrived plastic bag directly into your tank.



Guiding factors for BMP-4

- 5.1 A work sheet shall be developed for various parameters viz; swimming behavior, feed acceptance, water quality, fish mortalities (if any) etc. and shall be kept along with the quarantine tank.
- 5.2 The values/remarks on these parameters shall be recorded daily by a trained staff.
- 5.3 The format once developed shall remain in use for a long period of time without any change.
- 5.4 The period interval and time of recording data should be same throughout the total period of quarantine.

BMP 4

Practice of regular & frequent monitoring & record keeping on behavior, feeding and health of fish should be followed

A fish is subjected to quarantine in order to revive it from any stress and also to confirm that it is not the source of any disease.

Many a times, a fish may appear healthy initially but may show sign of disease after few days.

Therefore, a regular monitoring and record keeping of behavioural changes, feed acceptance and fish health is very important.

Record keeping is important because it allows the facility manager to ensure that the fish are being observed regularly, the system is being properly maintained, and that disease problems are tracked and reported in a timely manner.

BMP 5

Standard prophylactic treatments should be carried out to reduce stress & consequent incidence of diseases

A well known theory related to health management is Prevention is better than cure.

It is very well applicable during the process of quarantine.

The application of various prophylactic treatments acts as preventive measures.

Some of the commonly used prophylactic treatments for fish include dip, bath or prolonged immersion in common salt, formalin, potassium permanganate, acriflavin and hydrogen peroxide.

Guiding factors for BMP-5

- 6.1 Common salt: Only un-iodised and preferably rock salt shall be used. Freshwater fishes entering quarantine should be given a saltwater dip (Sodium chloride crystals 5gm/litre) if feasible, two more saltwater baths at 3- to 5-day intervals.
- 6.2 Formalin: Dissolve 1 ml formaldehyde in 10 liter of water and give an immersion treatment for about 1 hr. Formaldehyde could be easily obtained from a supplier of laboratory chemicals. Do not use a solution of formaldehyde which appears milky
- 6.3 Potassium Permanganate (KMnO_4): Dissolve 4 gm KMnO_4 in 1000 liter of water and give immersion treatment for 1-3 hrs. In case of prolonged treatment for 24 hrs quantity of KMnO_4 is reduced to 2.5 g per 1000 liters.
- 6.4 Acriflavine: Dissolve 500 mg of acriflavine in 1 liter of water and keep it as a stock solution. Stock solution could be diluted and used as per requirement.

Guiding factors for BMP-6

- 7.1 All tanks should be kept free of fish waste and uneaten food.
- 7.2 Ensure that all dead and moribund (sick) fish are removed promptly.
- 7.3 Equipment should be cleaned and placed in a disinfection solution for the appropriate amount of time after each use.
- 7.4 It is important to use an appropriate disinfectant, at the proper concentration, and allow the recommended contact time with all equipment and tank surfaces to assure efficacy (Table-1).
- 7.5 Buckets of disinfectants should be placed by each quarantine tank and each tank should have its own set of nets, bowls and siphons. After fish leaves the quarantine system, all tanks should be sanitized and if possible, allowed to air dry.

BMP 6

Appropriate sanitation procedures should be strictly followed for eliminating entry of pathogens

It may also happen sometime that the fish was disease free when it was brought to quarantine facility but it was subjected to pathogens there only.

It could be because of non adherence of sanitation procedure and maintenance of hygiene in the premises.

Table-1: Common disinfectants for use at Ornamental Fish production facility

Disinfectant	Dosage	Duration	Comments
Sodium Hypochlorite (Household bleach at 5.25%)	200mg/l (approx. 35 ml [2.5 tbsp] per gallon of water)	1 hour	Not recommended for nets or metal Maybe neutralized with sodium thiosulfate Toxic to fish
Quaternary Ammonium compounds	2000mg/l	1 minute	Toxic to fish
Calcium Hypochlorite	100-200mg/l	20 seconds	Toxic to fish

8. Important suggestions

- It is always better to have a quarantine facility at your hatchery/trade place.
- Quarantine area should be isolated and separate from your main facility.
- Acclimatize the fish properly, which is the foremost requirement of quarantine.
- Water quality parameters should be not only optimal but stable.
- Quarantine tanks should have viewing facility that is adequate to observe fish.
- Each quarantine tank should have its own sets of equipments/filter system.
- Standard prophylactic treatments should be carried out to reduce the stress and consequent incidence of diseases.
- Bottom of the tanks should be bare, without sand, plants or anything.
- Only authorized persons should be allowed to enter the quarantine area.

01:43:37.897,01:43:40.897

Mr. Vasu: culture of worms has been successful sir ????

Answer:

It is successful regarding culture of worms

Blood Worm (*Chironomus larva*)

Intermediate stage of midge fly
commonly called as bloodworms

Worms ideal live food source to all varieties of ornamental fishes

chironomid fly normally lays about 2000 eggs at a time
in any substratum of the stagnant water and
such eggs hatch out in presence of sunlight in a period of
about 3 days

Larvae attain optimum size in about 15-20 days,
when they are ready for feeding fishes.
These worms could be disturbing mud bottom



Larvae of *chironomus* feed on phytoplankton like
Nitzschia sp., *Navicula* sp, *Chlorella* sp, *Chlamydomonas* sp. etc.
Hence any organic manure, which helps in generation of these algae,
may be used for fertilizing pond to facilitate adult fly to lay eggs

Organic manures like cow dung, pigdung, poultry waste either alone or
in combination with groundnut oilcake and super phosphate may also be used
to enhance production of algae and flagellates

Tanks of any size may be used in production of *Chironomus* larvae
Larvae collected from wild should be washed and treated with suitable dose
of antibiotics in order to prevent bacterial or pathogenic infection.

Tubifex Worms

Annelids, which normally dwell inside tubular cases

Common in sludge banks or silty shores of aquatic areas
rich in nutrients

As they are available throughout year, supply is not restricted

As *Tubifex* contains n3 and n6 fatty acids,
ideal live food source especially for
brood fishes such as goldfish, angel and oscar.

Tubifex could also be cultured in race ways
fertilized with organic manures

For harvesting *tubificid* worms from wild habitats i.e, soil,
latter is first dried

During drying, animals would lump together and form balls

These balls should be washed in running water to remove
gut contents before feeding them to fishes



02:46:45.009,02:46:48.009

Karthikeyan K: where to sell the ornamental fishes..?

Answer:

The easiest, most hassle-free way to sell fish is to go to your local fish store. (Most big brand pet stores won't buy fish from local breeders because they already have contracts with large fish farms.

Sell through <https://dir.indiamart.com/>

See the PDF file attached

02:47:41.119,02:47:44.119

Paavana Arvind: Aquarium cleaning, should only water hange be done

Only or the whole tank should be cleaned

Regularly scheduled aquarium water changes include these benefits:

- Removes accumulating nitrates
- Waste particles settling at the bottom of the aquarium can easily be removed with a siphon
- Removes toxins and chemical pollutants
- Improves water clarity and removes odors
- Adding fresh water back into the aquarium increases available oxygen
- Replenishes depleted minerals and trace elements

Recommended Aquarium Water Change Schedule

The benefits of regular water changes

Our recommendation for general aquarium maintenance purposes:

- Weekly water changes of about 10% of the tank volume.
- Optionally, 15 – 20% every other week, works in most aquariums as well.

Using these weekly and bi-weekly guidelines, the schedule can be tweaked to suit each unique aquarium setup. In some cases less frequent water changes will work, while heavily stocked aquariums likely require more frequent changes.

Some trial and error is required to determine the most effective water change schedule for your own aquarium.

Some tips for maintaining your freshwater tank:

- For a smaller tank, change out 10%-15% of the water each week.
- For a larger tank, change 20% of the water each week.
- If you use tap water, allow it to sit for three days.
- Use a dechlorinator before pouring fresh tap water into your tank.
- Test the water quality daily to ensure balanced pH levels.

Schedule a water change every two weeks at a minimum – ideally, however, you should be changing a portion of your tank water once a week. If changing the water every two weeks, go for a 20% tank change each time. If you are able to perform weekly water changes, however, you may only need to change 10% to 15% of the tank water.

02:47:54.494,02:47:57.494

Thirunavukkarasu Balasubramanian: Where can we get the medicines which we using in farms to prevent diseases

S. No.	Name of Disease	Causative Agent	Clinical Signs	Treatment
1. NON-INFECTIOUS DISEASES				
1.1	Crooked body	Injury to spine during young stage Can be hereditary Faulty diet	Deformed body line Wobbling while swimming	Difficult to cure
1.2	Constipation	Imbalanced or poor quality diet	Appearance of a long thread like structure attached to vent, Fish becomes sluggish, Swelling of belly	Keep the fish on fast for some time, Feeding with Daphnia helps as they act as mild laxative, Salt treatment
1.3	Gas Bubble Disease	Super saturation with either oxygen or nitrogen in water	Gas emboli in fins, opercula, eye or gills	Agitate water, Increase water temperature
1.4	Brown Blood Disease	Presence of excessive nitrite in water (>0.1 mg/L) as a result hemoglobin turns into met-hemoglobin	Gills become darker, Excessive pumping of gills, Piping at the surface of water	Flushing of gills under increased flow of water.
1.5	Acidosis	Lowering of water pH	Increased mucus production, Disturbed Osmoregulation	Change the water, Add common salt @3 gm/L

2. INFECTIOUS DISEASES				
2.1 VIRAL DISEASES				
2.1.1	Lymphocystis	Iridovirus	Nodular white swellings (cauliflower) on fins or body	These diseases are frequently self limiting i.e. resolve on its own, Separate the affected fish, In severe cases, remove and destroy the infected fish as soon as possible, Avoid unnecessary netting or other materials in the pond, which are abrasive to fish skin, Always use disinfected equipments, Provide good nursing care including water quality, high quality feed, clean facilities etc.
2.1.2	Fish pox	Herpesvirus (virus is highly host specific for cyprinids)	Presence of glistening smooth, flat, milky to tan slightly raised plaques on the skin surface, Lesions get ulcerated and secondarily infected by bacteria, Affected sites become darkly pigmented.	
2.1.3	Spring Viraemia of Carps Virus (SVCV)	Rhabdovirus	Dark skin, Swollen belly, Exophthalmia, Haemorrhages in the skin and gills, Protrusion and inflammation of the vent, Internal oedema in all the organs	
2.1.4	Koi Herpes Virus Disease (KHVD)	DNA virus	Gill mottling with red and white patches, Bleeding gills, Sunken eyes, Pale patches or blisters on the skin	

2.2 BACTERIAL DISEASES				
2.2.1	Mouth Fungus	<i>Chondrococcus columnaris</i>	White cotton patches around the mouth first as a gray or white line around the lips and later as short tufts sprouting from the mouth like fungus	Bath treatment with antibiotics Oxolinic Acid: 25 mg/L for 15 minutes (Repeat twice daily for three days), Oxytetracycline : 50 mg/L for 15 minutes (Repeat twice daily for three days), Nifurpirinol: 66 mg/L for 15 minutes (Repeat every day third day upto three treatments),
2.2.2	Tail and fin rot	<i>Aeromonas, Pseudomonas & Myxobacterium</i>	Disintegrating fins that may be reduced to stumps exposed fin rays, Blood on edges of fins, reddened areas at base of fins	
2.2.3	Columnaris Disease	<i>Flavobacterium columnare</i>	Brown to Yellowish-brown lesions on gills/skin, Pale white band encircling the body often referred to as saddle back	
2.2.4	Fish Tuberculosis (Fish Mycobacteriosis)	<i>Mycobacterium fortuitum</i>	Anorexia, Emaciation, Loss of equilibrium, Exophthalmia, Dropsy, Grey-white nodules in kidneys, muscles, spleen	
2.2.5	Motile Aeromonad Septicemia (MAS)	Gram negative bacteria of genus i.e. <i>Aeromonas hydrophila</i> , <i>A. sobria</i> , <i>A. veronii</i>	Ulceration, Exophthalmia, Abdominal distention.	
S. No.	Name of Disease	Causative Agent	Clinical Signs	Treatment
2.3 FUNGAL DISEASE				
2.3.1	Saprolegniasis	<i>Saprolegnia</i> spp.	Cotton like growth on the skin and fins can cover large areas of the fish, Fungal attacks may lead to other health problems like parasitic attack, injury, or bacterial infection.	Bath treatment in water having malachite green, Long term bath in 3 ppm methylene blue

2.4 DISEASE CAUSED BY PARASITES				
2.4.1 PROTOZOAN DISEASE				
2.4.1.1	White spot disease- Ichthyophthiriosis	<i>Ichthyophthirius multifiliis</i>	Small white nodules first on fins then on entire body, Invade gills leading to breathing problem	Slightly raising of temperature, Bath treatment in a solution of Malachite green and Formalin.
2.4.1.2	Neon Tetra Disease	<i>Plistophora hypessobryconis</i>	Fading of normal brilliant colour, Equilibrium dysfunction, Muscular paralysis, Weight loss, Fin degeneration and death	Stock Solution: Malachite Green: 3.3 g Formalin: 1.0L Working Solution: Stock Solution: 2.5 ml Water: 100 L (one hour bath treatment alternatively for three days)
2.4.1.3	Trichodiniosis	<i>Trichodina</i> spp	Ciliate present on skin and gills, Reduced appetite, Weakened fish becomes susceptible to bacterial pathogens	
2.4.1.4	Costiasis	<i>Ichthyobodo</i> spp. (<i>Costia</i> spp.)	Heavy and labored breathing, Skin cloudiness caused due to excessive mucus, Flashing and rubbing, Clusters of parasites can sometime be seen on the edges of epithelium	
2.4.1.5	Hexamita (Hole in head disease)	<i>Hexamita</i> spp. Discus and other large cichlids are more prone to Hexamita	Small holes in head with a tiny parasite protruding, Ulcerations in lateral line, Loss of appetite, Weight loss	
2.4.1.6	Oodiniasis (Velvet Disease)	<i>Oodinium limneticum</i>	Clamped fins, Skin shows gray patches, which look like dust giving velvet appearance to skin, The fish may show signs of irritation, The disease is highly contagious and fatal.	

2.4.2 DISEASE CAUSED BY PLATYHELMINTHS				
2.4.2.1	Monogenean trematods (Flukes or flatworms) borne diseases	<i>Gyrodactylus</i> (Gill fluke) & <i>Dactylogyrus</i> (Skin fluke)	Fish scrapes itself against objects, Gills and body covered with mucus, Gills swollen, pale and show rapid movement, Scale loss with pink coloured fluid oozing out	Treatment with potassium permanganate / formalin
2.4.2.2	Black spot disease (Digenean Trematodes)	<i>Posthodiplostomum</i> & <i>Clinostomum</i>	Increased melanin deposit in skin due to encystment in skin, Respiratory distress as tematode gets encysted in gill tissues	
2.4.3	Disease caused by Nematodes	<i>Camillanus</i> , <i>Capillaria</i> & <i>Eustrongylides</i>	Could infect anywhere in the body but visible when they hang out of the anus, Emaciation, stunted growth, lethargy and death	Fenbendazole (an antihelminthes) is mixed with fish feed @ 0.25% and fed for three days and repeated after three weeks.
2.4.4	Disease caused by Annelids (Leeches)	<i>Piscicola geometra</i> & <i>Cystobranchnus</i> (Acts as ecto-parasites)	Leeches are parasitic on host's blood & visible on fish skin, Heavily infected fish often have chronic anemia, Secondary bacterial and fungal infection at the attachment site	In case of pond, disinfect the pond time to time with lime and bath treatment of fish in 2-3 % salt solution in case of aquarium.

2.4.5 DISEASES CAUSED BY PARASITIC CRUSTACEANS				
2.4.5.1	Argulosis	<i>Argulus</i> (Fish louse)	Visible as a small button like structure on boy of fish, Attaches itself to the body of fish with the help of sucker, Fish rubs itself against objects due to irritation, Fish can develop secondary bacterial and fungal infection at the attachment site	Could be hand picked using tweezers at early stages, Prolonged dip treatment in 5% salt, Bath treatment in 10-20 mg/L of KMNO ₄ for 30 minutes alternatively for 3 days.
2.4.5.2	Lernaeasis (Anchor worm)	<i>Lernaea</i>	Small hemorrhagic (bloody) spots, The fish scrapes itself against objects, Whitish-green threads hang out of fish skin (fins) with an inflamed area at the point of attachment and subsequently spread to mouth and alimentary canal	
2.5 DISEASES WITH INDEFINITE ETIOLOGY				
2.5.1	Pop eye	Bacterial or parasitic infection, Poor water quality, Internal metabolic disorder	One or both eyes protrude from the head, Eye lens become cloudy	Isolate the infected fish and treat with broad spectrum antibiotic, Provide good food and water quality conditions, Add Neomycin sulphate @ 50 mg/L .
2.5.2	Dropsy	Bacterial or parasitic infection	Concentration of fluids in body tissues or cavities resulting in abdominal swelling, Scale protrude out from body	Raise the temperature and add salt, it will help the fish to lose some fluid from the body, treat with broad spectrum antibiotics

02:48:00.902,02:48:03.902

Kirubai Vincent: More suitable and good profit breed in our area

Guppy / Molly / Platy / Sword Tail / Gold fish / Koi Carp

02:48:20.424,02:48:23.424

Raja Rajamanickam: who is to authorize to green certificate for Ornamental fish exports

See the pdf file attached

02:48:34.992,02:48:37.992

Premkumar Kathiresan: dhalpinia culture sample can i get

From Any Aqua Clinic Shop

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.brineshrimpdirect.com%2Fspecialty-fish-food-freeze-dried-fish-food%2Fdried-daphnia%2F&psig=AOvVaw0Ne_6r9fdkNUwzmiMG96GE&ust=1622360241509000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKDapoWx7vACFQAAAAAdAAAAABAD

https://www.google.com/url?sa=i&url=https%3A%2F%2Fwww.amazon.com%2FFreeze-Daphnia-Cichlid-Catfish-Tropical%2Fdp%2FB081F2BXOK&psig=AOvVaw0Ne_6r9fdkNUwzmiMG96GE&ust=1622360241509000&source=images&cd=vfe&ved=0CAIQjRxqFwoTCKDapoWx7vACFQAAAAAdAAAAABAI

02:50:12.179,02:50:15.179

Karthikeyan K: should i need to register as farmer in state fisheries department before undertaking ornamental fish farming ?

02:50:17.026,02:50:20.026

Paavana Arvind: How to make biological filter

Biological filtration is one of three different types of filters that can be used in your aquarium. The other two are mechanical and chemical filtration. Unlike the other filters, biological filtration uses living organisms to remove nasty substances from your aquarium. But not just any living organism...

Bacteria! If you are a germophobe, then just the very sight of that word will send shivers down your spine. But the bacteria used in biological filtration are your friends. If you want to successfully raise happy and healthy fish, you need these bacteria in your tank. Fishlab Fact: Any filter media that is designed to provide a home to the bacteria used in biological filtration is referred to as a *bio filter*.

Biological filtration works a little differently from the other methods of filtration. Mechanical and chemical filtration work by *removing* the unwanted stuff.

But that's not how biological filtration works... Instead, it converts one chemical to another. Now this may sound confusing, but it's actually very simple. Think back to the nitrogen cycle for a moment. Waste, such as fish poop or uneaten food, breaks down and releases ammonia. Bacteria then eat the ammonia and convert it to nitrite. And then, another type of bacteria converts nitrite to nitrate. This is biological filtration at work. Biological filtration refers to when bacteria in your tank eat any compound, such as ammonia, nitrite or nitrate, and then convert it into something else. You want these bacteria in your aquarium. That's why they are commonly referred to as *beneficial bacteria*! With enough beneficial bacteria in your aquarium, they will eat ammonia and nitrite as quickly as it is produced.

02:53:36.617,02:53:39.617

Thirunavukkarasu Balasubramanian: For my shop i have purchased fishes from farms but after adding to the stocking tank it will dyes day by day

Process of acclimatization

1. Turn off aquarium lights
2. Dim the lights in the room where the new arrivals will be opened. Never open the bag in bright light - severe stress or trauma may result from sudden exposure to bright light
3. Float the sealed plastic bag in the tank for 15 minutes (Fig. A). Never open the bag at this time. This step allows the water in the bag to adjust slowly to the temperature of the tank while maintaining a high level of dissolved oxygen.
4. After floating the sealed bag for 15 minutes, cut open the bag just under knot or rubber band (Fig. B) and roll the top edge of the bag down one inch to create an air pocket within the lip of the bag. This will enable the bag to float on the surface of the water (Fig. C). For heavy pieces bags that will submerge, place the bag in a plastic bowl or specimen container
5. Add 1/4 cup of tank water to the plastic bag (Fig. D).
6. Repeat step 5 every ten minutes until the arrived bag is full.
7. Lift the plastic bag from the tank and discard half the water from the bag (Fig. E).
8. Float the shipping bag in the aquarium again and proceed to add 1/4 cup of tank water to the arrived bag every four minutes until the bag is full.
9. Use a very soft hand net to gently catch the fish from the bag and release them into your tank (Fig. F)
10. Remove the filled plastic bag from the tank and discard the water. Never release water from the newly arrived plastic bag directly into your tank.



02:55:44.652,02:55:47.652

Thirunavukkarasu Balasubramanian: List out scaleless fishes please

Types of scaleless fish.

Sea lamprey.

Pacific hagfish.

Rat fish.

Conger eel.

Mediterranean moray.

Black bullhead catfish.

Which Pet Fish Don't Have Scales?

Cat Fish / Sharks / Rays / Eels

02:56:26.509,02:56:29.509

Paavana Arvind: How much quantity should fish be fed if it is a 3 inch Fish

Period	Total Biomass (1000 nos.)	Feeding rate*	Amount of feed
1 st to 4 th Week 1 st month)	1.5 g	4-6 times of the fish body weight (BW). It is best to give frequent feeds in small quantities during initial days	6.0 – 9.0 g daily
Fry	100 g	5-10 % BW	5 -10g daily
Fingerling	1000 g	3-5 % BW	30 – 50 g daily
Grow out	10000 g	2-3 % BW	200 – 300 g daily

* Co-feeding with natural / live food is essential for better growth and development

Fish age	Frequency	Remarks
1 st to 4 th week	3-4 times a day	Alternate feeding with dry / live food for optimum fish growth / colour enhancement
Up to 3 months	Thrice a day	
After 4 months (for grow out & brooders)	Twice a day	

02:57:16.281,02:57:19.281

Kirubai Vincent: Best suitable breeds for new starting breeding....

Guppy / Molly / Platy / Sword Tail / Gold fish / Koi Carp

02:57:30.628,02:57:33.628

Paavana Arvind: How many days the fish has to be quarantined before Transportation

3. BMP-2: A proper conditioning of fish prior to packaging is the key to the success of entire packaging and transport process



Conditioning refers to clearing the fish of all the gut contents and acclimatization to the tank environment. It is during the conditioning processes that fish are graded according to the size and damaged fishes are removed.

Guiding factors to BMP-2

3.1 Removal of dead or damaged fish

Once all the fish are shifted to tank from pond, dead fish, if any, should be removed and disposed off safely. Any damaged or injured fish should also be removed and shifted to quarantine tanks.

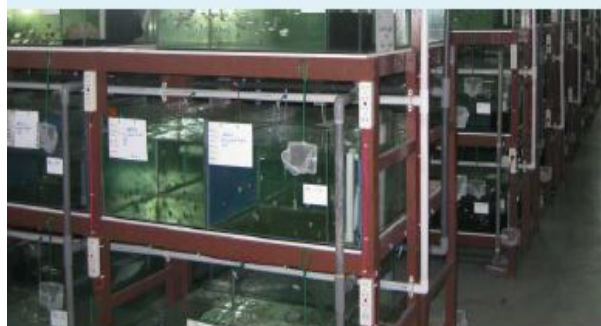
3.2 Grading as per size

Ornamental fish will attract better price if these are of the same size. Hence, fish are graded according to the size. Grading could be done manually or by auto grading systems that uses screens of different mesh sizes.

3.3 Water exchange

The water of the conditioning tanks is treated with common salt @ 3 gm/litre and about 70% water is exchanged daily. Fish are kept in conditioning tank for 1-2 days and now could be termed as "Tank Fish". Fish should be visually examined very carefully for any external parasites, or any sign of distress like erratic swimming, clamped-fins, abnormal opercular movement etc.

3.4 Shifting in glass tanks



Fish are thereafter counted and shifted to glass tanks which are also provided with aeration and water re-circulation facility. Since grading and counting consumes a lot of time, it should be done well in advance. The water is treated with methylene blue (@ 0.0035 ppm) and common salt (@ 0.1 ppt). Fish are kept there for a minimum of 1 to 2 days as per the packing schedule.

4. BMP-3: Fish should be starved before packaging that allows higher packing densities

Fish may vomit or defecate in the bags when not purged. It will also contaminate the water in the packing bag leading to bacterial blooms. Starving also slows the metabolic rate of the fish. It helps in reducing oxygen requirements of the fish, reduces ammonia and carbon dioxide output and allows higher packing densities.

Guiding factors for BMP-3

4.1 Period of starving

Most species require a starving period of 1 day prior to transport but larger fish and herbivorous fish may need 2 or more days for sufficient starving. Mollies may require still longer period for starving.

4.2 Stage of starving

Starving cannot be done in ponds or tanks where there are natural foods available. It is generally not possible to achieve good purging in production ponds and it is recommended that this be undertaken in glass tanks only.

02:57:39.313,02:57:42.313

Thirunavukkarasu Balasubramanian: For scaleless fishes can we do salt bath to cure the fish diseases

Scaleless fish: Scaleless fish species do not have the added barrier that scales provide, so they cannot tolerate much salt. The *Corydoras* catfish are particularly sensitive to salt; as are Tetras. Salt use in aquariums with these species should be no more than 1 level teaspoon per gallon of water (= 0.1% salinity).

02:59:11.750,02:59:14.750

Paavana Arvind: Are pleco fish good for aquariums
Quick Facts About Common Plecostomus

Common Name (species)
Common Plecostomus (*Hypostomus plecostomus*)
Family Loricariidae
Origin Central and South America
Size Range

Average 15-inches in length, but adults range from 12 to 24-inches at maturity

Compatibility

Juveniles may initially be kept in peaceful community tanks and with other Pleco species, but they often become aggressive with age. Adults are best kept on their own or in a community tank with large, aggressive cichlids like Oscars or Green Terror

OK for Planted Tanks

Ideal for planted aquariums, but may consume plants rather than eating wood or algae. Adding blanched vegetable treats and/or fast-growing Hornwort may protect plants from damage

03:00:41.428,03:00:44.428

Karthikeyan K:

how to maintain PH value when there is a fluctuation?

What are the effects of pH in the aquarium?

High Alkaline

pH changes in the aquarium, even if small, can have serious health effects on your fish. High alkaline, aka basic water, can affect your fishes' gills. If your fish dart back and forth, check your pH, as this is a common symptom of high alkaline and may result in fish death.

High Acid

An acidic aquarium can result in the production of excess mucous by your fish. This is due to an increase of toxic elements promoted by acidic aquarium water. Other observable symptom include fish gasping, hyperplasia (thickening of skin and gills), and eye damage. As with high alkaline, fish death can occur.

How do I adjust the pH in my Aquarium?

How to increase your aquarium's pH

A common method of raising the aquarium's pH is by adding baking soda. 1 teaspoon of baking soda per 5 gallons is generally considered a safe amount for small incremental increases.

It's best to remove the fish from the tank prior to raising the pH. Then simply dissolve the required amount of baking soda in some conditioned water and add it to the aquarium. Once the pH is at the desired level you can re-introduce the fish just like you would when you first brought them home from the store.

You should never make sudden and large pH changes, as this will have a severe effect on your fish. Start with 1 teaspoon per 5 gallons of water and slowly raise the pH incrementally. This will allow your fish to acclimate to the new tank conditions.

- add crushed coral
- add dolomite chippings

How to lower your aquarium's pH

Using peat moss is a common way to lower the aquarium's pH. Simply put the peat moss into a mesh bag and add it to the filter. Peat moss will

gradually lower the pH. With peat moss, it is likely however that your water will temporarily discolor. It should clear up over time and you can also use activated carbon to help it along.

Other methods of lowering the pH include:

- Decrease aeration of the aquarium
- Driftwood will soften the water and lower the pH
- Increase CO₂ levels (planted aquariums)
- Adding RO water

What influences the pH in the aquarium?

- The pH level can be different before and after water changes, especially if the pH of the aquarium water and the aquarium itself vary
- Decreased aeration will lower the pH
- driftwood will soften the water and therefore lower the pH
- adding CO₂ will lower the pH
- high nitrates can cause the pH to drop
- pollutants and waste in the water will lower the pH
- crushed coral (substrate or ornaments) will increase the pH
- hard water will cause higher pH levels
- using a water purifier can lower pH levels (good with hard water)
- soft water is generally low in pH
- RO water has a pH of 6 or lower
- overstocked aquariums can be low in pH

03:00:59.172,03:01:02.172 / salim khadermohideen:

For a new starter how much investment, place needed, for a minimum profit and how much? And what varieties to start in the beginning?

Capital Investment	
Cement Tanks (20 Numbers @ Rs. 500 / Tank	10,000
Air Pump (1 Number)	7,000
Pumps & Others	2,500
Glass Tanks (2 Numbers)	500
Total	20,000
Recurring Expenditures	
Brooders Cost	3,000
Feed Cost	5,000
Medicines / Chemicals / Fertilizers	500
Other Miscellaneous Expenses	1,000
Total	9,500

Production	
Sale of Egg Layers (60,000 Numbers @ Rs. 3 / fish)	1,80,000
Sale of Gold Fish (40,000 Numbers @ Rs. 6 / fish)	2,40,000
Sale of Fighters & Gourami (25,000 Numbers @ Rs. 5 / fish)	1,25,000
Total Income / Year	5,45,000
Interest on C I (12 %)	2,01,600
Recurring Expenses	1,50,000
Net Income	1,93,400

Production	
Sale of Egg Layers (20,000 Numbers @ Rs. 2 / fish)	40,000
Sale of Gold Fish (5,000 Numbers @ Rs. 5 / fish)	25,000
Sale of Fighters & Gourami (3,000 Numbers @ Rs. 4 / fish)	12,000
Total Income / Year	77,000
Net Income / Year	47,500

03:01:22.695,03:01:25.695

Kirubai Vincent: Open cement Farming need shade area or can use open Place

It is better to have in open one

Payment Transaction Reference Number for All Participants

Sl. No	Date	Reference Number	Amount
1	13.05.2021	UPIAB/113320685978/CR/RAJAMANI/SBIN/rajashrimp@oks (Rajamanickam)	300
2	14.05.2021	NEFT:Mr VASANTHA KUMAR SBIN121134446931	300
3	14.05.2021	2021 IMPSAB/113412292251/UBIN0536491/9942355188	300
4	15.05.2021	NEFT:Mr ABHISHEK MAJHI SBIN221135187549	300
5	17.05.2021	UPIAB/113719297097/CR/ARVIND N/HDFC/nr.arvind@okhd	300
6	17.05.2021	UPIAB/113721105167/CR/SALEEM K/SBIN/saleemkhadermo	300
7	20.05.2021	UPIAB/114054145662/CR/KHANDU D/SBIN/8167402575@pay	300
8	20.05.2021	IMPSAB/114012619113/UBIN0536491/9092238086	300
9	21.05.2021	UPIAB/114112706105/CR/Mr WANSH/CBIN/shaphrangtiews	300
10	23.05.2021	NEFT:E SANKARAMAHARAJAN IOBAN21143351251	300
11	27.05.2021	IMPSAB/114703466157/UBIN0536491/8778825934	300
12	27.05.2021	IMPSAB/114716360447/UBIN0536491/9444398733	300
13	27.05.2021	UPIAB/114716622258/CR/GIRISH C/PUNB/girishnainwal@	300
14	27.05.2021	IMPSAB/114717377811/UBIN0536491/9952511495	300
15	27.05.2021	NEFT:M RAJAN AXMB211477071347	300
Total			4,500

**Further Information,
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