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Ornamental fish rearing and breeding- a new dimension to aquaculture entrepreneurship in Himachal Pradesh

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Abstract

Ornamental fish production is a multibillion dollar industry. Ornamental fish keeping is becoming popular as an easy and stress relieving hobby. Asia is the biggest exporter of ornamental fish. India's share in ornamental fishes is estimated to be Rs.158.23 lakh which is only 0.008% of the global trade. It is becoming popular day by day. Therefore, many entrepreneurs are venturing into this lucrative business which in turn facilitates the growth of overall subsector. About 90% of ornamental fish is traded from Kolkata followed by 8% Mumbai and 2% from Chennai. Ornamental fisheries trade is having potential for tremendous growth, low production rate and high returns within a short span of time and even growing demand is a major attraction. Fifty-eight ornamental fish species belonging to five orders, 13 families and 36 genera occur in Himachal Pradesh. The indigenous ornamental fish which are available in the rivers of the state are being neglected due to lack of awareness. These indigenous ornamental fishes can easily be collected from the wild resources and can be cultured and reared for keeping in the aquarium.

Keywords: Ornamental fish, world trade, entrepreneurship, indigenous fish

1. Introduction

The '**fisheries and aquaculture sector**' is recognized as the sunshine sector in Indian agriculture. It stimulates growth of a number of subsidiary industries and is the source of livelihood for a large section of the economically backward population. It has a huge export potential and is a big source of foreign exchange earnings for the country. World trade of ornamental fishes has reached more than one billion dollars and it's growing rapidly at around 14% per year [1]. It not only provides essential self employment to the rural as well as urban entrepreneurs, but also valuable profits in term of foreign exchange. It is, therefore, imperative to understand in detail about their various breeding behaviour including their sexual differentiation, larval rearing, water chemistry, nutrition, diseases etc. An innovative entrepreneur can earn much higher profits by implementing such activities. Ornamental fish culture becoming a source of income day by day for the rural people in other states of our country. Therefore, there is an urgent need for up scaling the operations in this area, keeping in view the mammoth requirements in the state.

Ornamental fishes really are nature's wonderful creation. Ornamental fish keeping is the second most preferred hobby in the world and the number of hobbyists for ornamental fish keeping is rising day by day because it provides great opportunity for entrepreneurship development and income generation. The state has enormous potential for fishery in terms of aquatic resources with approximately 300km of perennial rivers, 775km of seasonal rivers (Satluj, Beas, Ravi, Chenab and Yamuna), 60,000ha reservoirs and 2,000ha, lakes and ponds including two Ramsar Sites, Pong Dam and Renuka Wetland [2]. Estimated fisheries, water resources of the state are around 3000 km [3]. The number of households interested in keeping ornamental fish in aquarium is increasing rapidly. However, there is no local production and supply of ornamental fish currently in Himachal Pradesh. Due to import, the price of ornamental fish is Rs. 100 – 400 per pair. Therefore, the success of ornamental fish culture in the state could meet the local demand and also provide an additional income to the farmers. There is a dire need for development of ornamental fish breeding and culture practices and technology in Himachal Pradesh.

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Tapping into the huge potential of ornamental fishery as a livelihood option and foreign exchange earner there should be scheme for setting up of breeding units of colourful aquarium fish. Fifty-eight ornamental fish species belonging to five orders, 13 families and 36 genera occur in Himachal Pradesh [2]. It has also been noticed that Indian ornamental fishes having aesthetic values are of greater demand in international market for aquarium keeping. The main markets are the United States of America, the United Kingdom, Belgium, Italy, Japan, China, Australia and South Africa. Many Indian species like catfish, dwarf gouramis, and barbs are popular abroad and fetch good price [4].

History

Aquaculture is a booming sector, which provides vast opportunities for entrepreneurship and livelihood generation. Ornamental fish form an important commercial component of aquaculture, providing for aesthetic requirements and upkeep of environment. 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 1855 in United Kingdom. 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 [5].

Aquarium keeping of fish began in 1805 with first public display aquarium opened at Regent park in England in 1853. Development of aquaria picked up further and by 1928 there were 45 display aquariums open to public with over 500 aquaria presently functioning worldwide. However, the market for ornamental fish in the world for public aquaria is less than 1% at present and over 99% of the market for ornamental fish is still confined to hobbyist. The brilliant, flamboyant colour and exotic appearance of fish appeals to

one and all, children and aged alike. Relatively less requirement of space or attention compared to other pets' animals is the reason of growing interest all over in aquaria keeping. Further setting up of aquarium is still relatively inexpensive and can be fitted at any location of the house, wherever there is diffused light.

In India hobby of ornamental fish keeping is nearly 70 years old and dates back to pre-independence era⁷. It begins with British raj and continuing till date. As the days passed ornamental fish keeping become an interesting activity for many, in the process generating income for unemployed youth and farmers. The concept of entrepreneurship development through ornamental fish farming is gaining popularity day by day. Being beautiful aquatic animals, a beginner, be he/she a hobbyist or an entrepreneur, would like to know more about the farming practices of these fish. Therefore, more and more people are entering into this lucrative business of culturing and breeding these fish through farming. As a result, many ancillaries as also pet shops were coming up in cities.

World trade of ornamental fish

The trade in ornamental fish has increasing since the 1980's. The value of ornamental fish trade has grown significantly over the past decades. Between 2000-2011, global exports of ornamental fish increased from US\$181 million to US\$372 million. Most of market supplies originate from Asia with Singapore dominating as the top exporting country in the world. In 2013, Singapore exported around US\$56 million worth of ornamental fish to over 80 countries [1]. Asia accounts for 51% of exports, Europe 29%, North America 4% and South America 6% [8]. The largest exporters of ornamental fish are Singapore (21% market share), Malaysia (8%), the United state of America (3.5%), Spain, the Czech Republic, Japan, Thailand and Israel [9].

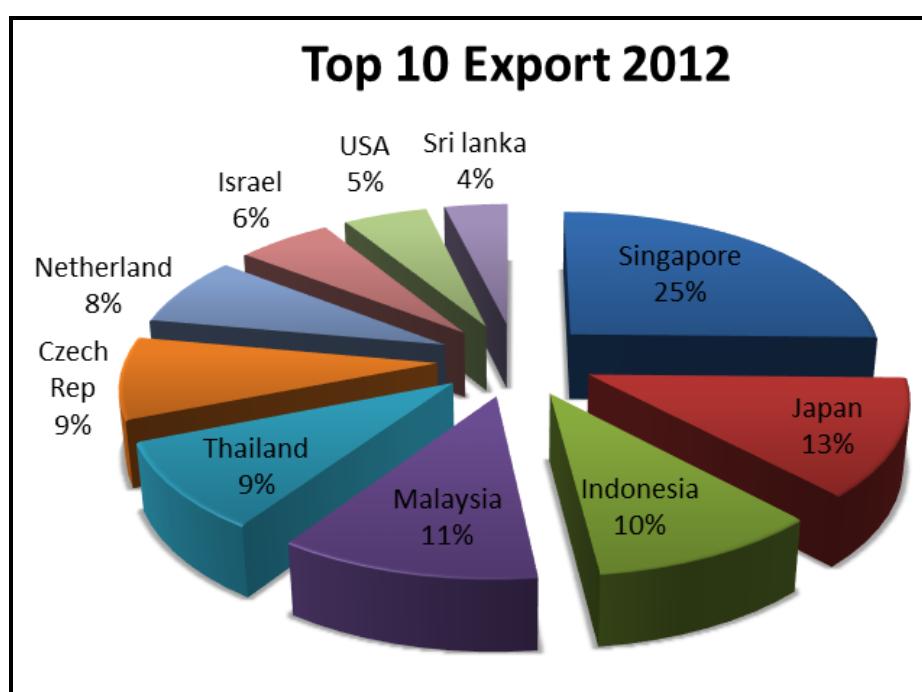


Fig 1: Top 10 export countries of ornamental fish in the World (2012)¹⁴

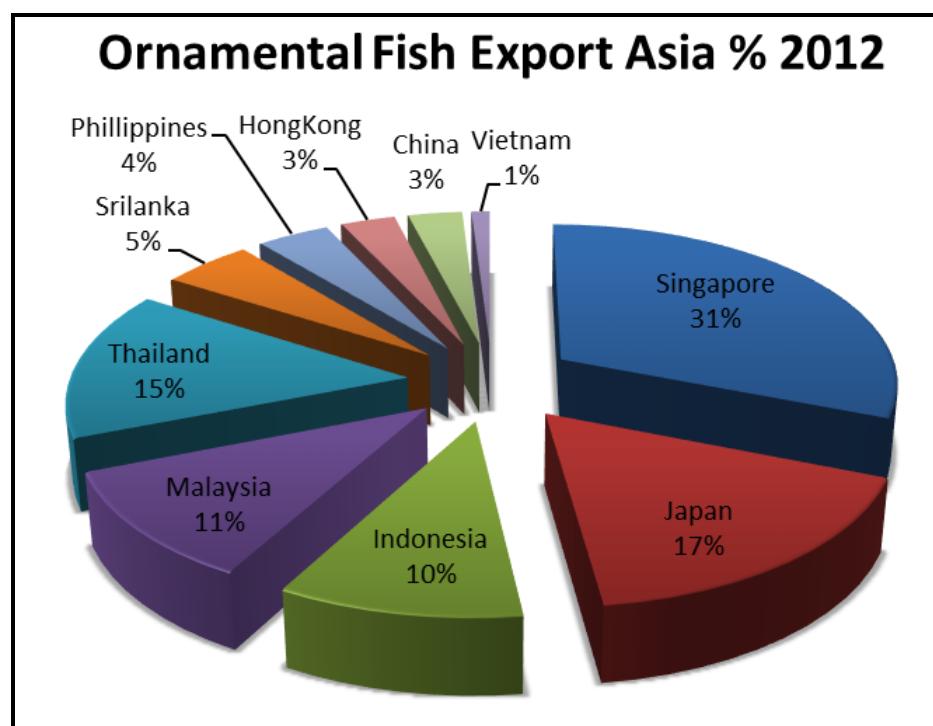


Fig 2: Asian countries percent export of ornamental fish (2012) ^[14]

Prospects of commercial production in India

The export of ornamental fishes from the country at present is mainly confined to freshwater varieties and export is limited to fishes collected from nature predominately in North-eastern states (85%) and a few bred varieties of exotic species (15%) ^[4]. In spite of availability of marine rich fauna. India share to global ornamental fish trade is less than 1% but still projected as sleeping giant because of yet untapped potential recourses¹⁰. In recent times, the sector has shown tremendous growth due to the efforts of farmers and entrepreneurs and developmental efforts of Government agencies. Therefore, many entrepreneurs are venturing into this lucrative business which in turn facilitates the growth of overall subsector. About 90% of ornamental fish is traded from Kolkata followed by 8% Mumbai and 2% from Chennai ^[11]. These metropolitan cities are also the major breeding centres for freshwater ornamental fishes. There are about 5000 units (small to large) located in the country till 2017. There are 5000 aquarium shops are located throughout the country. The total value as of now from domestic trade has reached INR 250-300 crore with the potential of INR 1000 crore. By seeing the increasing demand and interest in ornamental fish the figure should have increased considerably by this day.

Status of Himachal Pradesh in ornamental Fisheries

The state is richly endowed with a hilly terrain having an enormous volume of water. In the hills subsistence agricultural practices are not very lucrative and remunerative, to improve the socio-economic status of poor farmers as such there is dire need of integrated and diversified farming system. Presently carp and trout farming is gaining popularity in the hill region, but ornamental fish rearing and breeding is almost negligible in the state. We need to think beyond food security and give our farmers a sense of income security. The purpose is to increase ornamental fish production, income and alternative employment opportunities of vulnerable people (unemployed youth, women) through promotion of small-scale aquaculture and enterprise related activities. Therefore, in this way they can overcome own economic crisis and as

well as to restored livelihood security. Demand of ornamental fish is great. As almost every town of Himachal Pradesh is having ornamental fish shop. There are more 20 main outlets in Himachal Pradesh, which deals with ornamental fish. But they all bring their stock from different states, especially from Calcutta. So the present scenario is high demand and no supply from the state. So this venture has a great potential in the state, but not opted by the farmers of the state due to lack of knowledge. Breeding and rearing of ornamental fisheries is very less in the state. Only few state farms are breeding ornamental fishes on trial basis. It has to popularise among farmers of the state. There is great demand of these fish as people are taking interest to have aquarium in their houses as well as at their work place. In lower areas of the state where temperature is warm almost all the species can easily be bred while in hilly area where temperature falls very down during winters gold fish and koi carp can be a good option. So, it is the need of time that this venture should be popularised in the state so that people can earn money without much investment and time.

Common freshwater ornamental fishes

Indian water posses a rich diversity of ornamental fish, with over 100 varieties of indigenous species, in addition to similar number of exotic species that are bred in captivity. Further, our vast potential of natural resources in comparison to other potential countries like Singapore, Sri Lanka, Malaysia, Indonesia and many African countries offered great scope and possibilities for commercial production and export ^[12].

A wide range of ornamental fishes, ranging from cheap guppy to costly neon tetra is bred by aqua culturist and are available almost at every city and town. Breeding of ornamental fish does not require any sophisticated equipment, instruments and aquarium. Breeding can be achieved even in any spare tank. One basic requirement is a clear understanding of habits and biological requirement of fish. Hobbyist could study the behaviour and biology of fish during aquarium maintenance and can breed several varieties of fish. Water quality parameters including temperature, plant and lighting are

important factor influencing spawning and successful rearing of fry. Most of popular varieties of tropical ornamental fish are only about 3-4 cm long and can be kept in considerable numbers with in a moderate size aquarium.

Aquarium fish are broadly grouped into two categories on the basis of breeding behaviour viz., egg layer (oviparous) and live bearers (ovo-viviparous). Important groups of egg-layers are barbs, goldfish, tetra, danio, betta, cichlid and gourami. Major live bearers are guppy, platy, molly and swordtail, and their variants [6].

Barbs are one of most important group among egg layers and most species of the group are known to have originated from India Viz, rosy barb (*Pethia conchonius*), tiger barb (*Puntigrus tetrazona*) striped barb (*P. fasciatus*), Aruli barb (*P. arulius*), Narayan barb (*Pethi narayani*). Major species of group of Danios include vgaint danio (*Danio aequipinnatus*), pearl danio (*Danio albolineatus*) and Zebra danio (*D. rerio*). Zebra danio is typical example of ornamental fish species of Indian origin, which are bred and reared easily. Goldfish (*Carassius auratus*) is most commonly pretty fish, preferred by most hobbyist because of its attractive colouration ranging from pure gold to red, orange black and albino to a range of shapes and sizes. Some of the common varities of goldfish available are comet goldfish, lion head, oranda, fringe tail, veiltail, fan tail, shubunkin, telescopic eye, Lichi gold etc. Some of gold fish grow upto 20 cm in length, but start breeding when they are 6 cm in some cases.

The tetra are small fishes are of 3-8 cm long, majorities of which have originated from south America. The most common species 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*), pretty tetra (*H. pulcher*) etc.

The species, *Betta splendens* popularly known as Siamese fighting fish or betta occurs in varied colours like green, red blue, albino and sometimes with a combination of more shades. The attractive colour and hardiness of the species are its characteristics for its wide adoption by hobbyists. The

males are brightly coloured and with beautifully spread-over fins. They become aggressive in presence of other males. Angel fish is another important group of candidate species widely preferred, with different varieties such as black, veil tail, marble and albino.

Live bearers are the second group of ornamental fishes, giving birth to young ones and reproducing only a few numbers of offspring in comparison to egg layers though their breeding is relatively easy. Development of young ones takes place inside the female and are released after about four weeks' time. The species of livebearers include guppy (*Poecilia reticulata*), black molly (*Poecilla sphenops*), swordtail (*Xiphophorus helleri*) and platy (*X. maculata*). The number of babies produced by live bearers is normally 50-60only, through some larger sword tails may reproduce as many as 100 nos. If the live bearers are fed properly with natural food, supplemented with better artificial feed, the mother produce more than 100 young ones. Soon after the babies come out from the mother, they have to be separated out or in a system where the young ones can escape from the mother, thereby the mortality caused by predation/cannibalism could be checked [6].

Culture Facilities

Most common culture facilities used for ornamental fish are cement cisterns, glass aquaria, earthen ponds, earthen pots, etc. Three to four cement cisterns are sufficient for a small scale rearing unit (3m x 2m x 1m) and are built above the ground level for easy drainage. All glass aquaria are preferred for breeding purposes where heaters and aerators can be used easily. Even, fish farmers with small earthen tanks can use them for rearing juveniles with the food fish. Marginal farmers even can use large earthen pots of 1.5m diameter for rearing of larvae and juveniles. Generally, rain water is the best source of water for ornamental fish culture. If the municipal supply water is in use, before using, it is aerated for couple of days for de-chlorination. Tube well water is also used directly in the rural areas. The average temperature of the rearing water in the area is 15-28°C and the pH is slightly alkaline. Most of the species cultured prefers soft to medium hard water.

Table 1: Water quality paamenters ideal for breeding of some important ornamental species [13]

S. No.	Name of the fish	Water temperature In °C	pH	Water hardness (mg/L CaCO ₃)
Egg layers				
•	Gold fish (winter breeder)	18-20	7.0-7.5	90-200
•	Koi carp (winter breeder)	20-22	7.0-7.5	70-200
•	Angel (summer breeder)	24-30 (breeding) 28-30 (larval rearing)	6.3-8.5	70-200
•	Gourami (Summer breeder)	24-30	6.0-7.0	60-100
Live bearer				
•	Sword tail	28-30	6.5-7.5	80-250
•	Platy	28-30	6.5-7.5	80-250
•	Guppy	28-30	6.5-7.5	80-250
•	Molly	28-30	6.5-7.5	80-250

For small scale culture a minimum of 500 sq. ft land area is required where the farmer can construct few rectangular concrete tanks. For big projects more than 1ha land area is required and a number of earthen ponds required in addition to cement tanks for the culture of koi carp, catfish, gourami and barbs.

Prerequisites for ornamental fish culture

- A shade facility is required above the cement tanks and

anti-bird nets are required above the earthen ponds for breeding and rearing of ornamental fishes.

- Sufficient water and electricity supply at the breeding and rearing units are important.
- Selection of the quality brooder is the most important aspect for the success of the unit. Some species reproduce in soft acidic water, while a few others prefer hard alkaline water to breed.
- Live bearers usually prefer to breed in hard alkaline

water, while fishes like Angel, Discus, Tetra, Oscar and Loaches prefer soft acidic water. But other egg bearers like goldfish, danio, catfish, rosy barb, and fighter fish can tolerate a wide range of water.

- Bio-filter is essential for proper water quality management in the production unit.
- To increase breeding viability, avoid breeding of same fish for more than 2 years. Instead of that, fishes must be collected for far different places.
- Farm made aqua pellets can be prepared by using different agricultural by-products, for which a small pelletizer is required. The farmer can also use the commercial fish/prawn feed available in the market.
- Live food like Zooplankton, *Tubifex*, Blood worms, Chopped Earthworms etc. are also very much essential for brood fishes and larvae.
- For proper marketing of fish, better communication facility (roadways/ rail/ airport) is required nearby to the farm. Constant touch with small, middle, or large traders will benefit the farmer in marketing of his product.
- Prospective farmers can avail training and new methods demonstration to get knowledge about the new know-how in their respective field of interest and expertise.

Feed and Feeding

The small-scale farmers cannot afford different readymade packed pellet feed or purchasing of artemia cyst drum, which are costly. However, they have successfully substituted low cost alternative live feeds. Water fleas, *Tubifex* or sludge worm, mosquito larvae and chopped earthworm are used by the farmers. Different homemade feed like whole-wheat bread, vegetable peelings and rice are also fed. However, most farms depend on *Daphnia*, *Tubifex* worms and mosquito larvae. The fish culturists can collect *Daphnia* from the nearby ponds by sieving through fine mesh in the early morning. *Tubifex* worms and mosquito larvae are collected from the sewage water channels. Generally, the farmers dispense the feed once daily. Overfeeding is more harmful than under feeding as the excess feed destroys the water quality.

In aquarium industry, live food is the largest single item that influences the operational cost. The success and running of aquarium fish breeding and culture unit depends upon constant supply of live food in its vicinity. A starter diet like live infusoria for larvae and for adults, Monia and *Tubifex* can be cultured besides readymade cyst for brine shrimp available in the market. Live food contains 60-65% crude protein: 8-9% crude fat and 4-5 % crude fiber besides other micro-nutrients. The carotenoid pigments for enhancing the colour of ornamental fishes can be derived from these live foods. Thus, live food is considered as "living nutritious capsules" as they contain all the essential nutrients which enhance the breeding efficiency and excellent growth of fish, besides proving vibrant colour.

Most common aquarium fish should be fed twice a day, but each feeding should consist of only as much as it is consumed in five minutes. Overfeeding is feeding too much at a time, rather than too often. Uneaten food contributes to poor water quality which causes water cloudiness, rapid algal growth, and often leads to fish diseases. Alternative feeding with live feed and pelleted food will provide a well-balanced diet for fish^[6].

Management of water quality parameters

Ornamental fish production unit required higher level of expertise for better water quality management as ornamental fishes are more sensitive to poor water quality. Many ornamental fish will perish in situations where more robust food fish species can survive. As ornamental fish are kept in tanks more numbers than their food fish counterparts, water quality is most critical. Where large numbers of fish are kept in small spaces, the build-up of nitrogenous wastes, most notably ammonia, requires the producer to implement measures to manage it properly. Regular water exchange along with proper aeration overcomes this type of problem in the tanks. The more important physical and chemical qualities of water influencing aquatic productivity are temperature, pH, dissolved oxygen, free carbon dioxide, total alkalinity, water hardness, free chloride, ammonium, dissolved nutrients, like nitrogen, phosphorus, potassium, calcium, magnesium and silica.

Other works which can be done along with breeding and rearing of ornamental fish

The main area in which fisheries enterprise can be developed are feed manufacturing, marketing and sales, ornamental fish culture and breeding, aquaculture, hatchery and seed production, net making, fish disease diagnostic center, consultancy services and establishment of agri-clinics.

Aquarium plant propagation

Propagation of aquarium plants is recognized as one of powerful and growing industry in aquarium trade in many parts of the world. There are several producers of aquarium trade in many parts of the world. There are several producers of aquarium plants in many parts of the world. In Singapore, ornamental plant growing is a major industry and the produce is being exported to all parts of the world. In India aquarium plant propagation is new to the entrepreneurs. However, due to lack of expertise and demand the plant growing enterprise has not reached to expected levels.

Aquarium fabrication

One can easily fabricate an aquarium by purchasing a tube of silicone rubber and a gun. If aquarium is rectangular than 5 pieces of specific glass cuts are necessary. The back glass may be replaced with mirror, but people always prefer to put plant or rock screen rather than mirror. One silicon rubber tube can fix 5-6 number 2.5 cubic feet aquarium. Person can also involve with selling of glass cover, hood, aquarium stand and different items used for beautification of aquarium.

Aquaponics

Aquaponics is the integration of recirculating aquaculture and hydroponics in one production system. In an aquaponics unit, water from the fish tank cycles through filters, plant grow beds and then back to the fish. In aquaponics, the aquaculture effluent is diverted through plant bed and not released to the environment, while at the same time the nutrients for the plants are supplied from a sustainable, cost effective and nonchemical source. In aquaponics system nitrifying bacteria has a major role because they convert fish waste (ammonia) into plant food (nitrite). The key factor for maintaining healthy bacteria are water temperature, pH, dissolved oxygen and adequate surface area on which bacteria can grow.

Conclusion

In recent years, ornamental fishes are receiving increased attention due to the local and global demand and the consequent growth of the export market and trade. In the contemporary times of space restrictions and craze for beautifying interiors, the aquariums have become an integral element of homes, offices, hospitals, hotels, business establishments, airports and other institutions.

Ornamental fish production is a popular and financially viable business in many countries all over the world. Good return can be obtained by minimum investment as it can be started from a room and even in earthen pots. It can be done along with other vocation and can add to the income of the farmer. Farmers who are already involved in aquaculture they can start it without additional investment or other can go for low cost hatchery. This will lead to low cost and high returns.

Culture and breeding of ornamental fishes can be a promising alternative for many people as well as unemployed youths of the state. It requires little space and less initial investment than most other forms of aquaculture. For ornamental fish farming, only a clear understanding of habits and biology of the fish is required. It can be practiced even in urban areas with little alteration of backyard or roof of a house. As less manpower is needed, the women or the elders can run small home aquarium units and improve their social and economic life.

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