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# Mini RAS (Recirculatory Aquaculture System) for broodstock maintenance in Marine Ornamental Fish Hatcheries

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**Ramanathapuram District**
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# PREFACE

Marine aquarium keeping is increasingly becoming popular in the Indian context these days. Eventhough collection from the wild continues to be the major contributor in the trade, it is imperative to shift gradually from the wild collection to captive breeding and seed production of marine ornamental fishes in order to ensure a sustainable development of the sector. The ICAR - CMFRI has developed the technology for breeding and seed production of around fifteen varieties of marine ornamental fishes such as clown fishes and damsel fishes. Many fisherwomen SHGs and individuals in the maritime states have already ventured into small scale production of marine ornamental fishes. As broodstock development is an important part of the breeding programme, more emphasis need to be given on this component to ensure better larval survival and production of healthy larvae. The mini RAS (Recirculatory Aquaculture System) developed for brood stock maintenance would be highly useful for a small scale marine ornamental fish breeding and seed production unit. This document outlines the basic working and various components of the mini RAS besides giving the economics for setting up and operation of a marine ornamental fish breeding and seed production unit. I congratulate all those who were involved in preparation of this document.

**Dr. A. Gopalakrishnan**
Director, ICAR-CMFRI

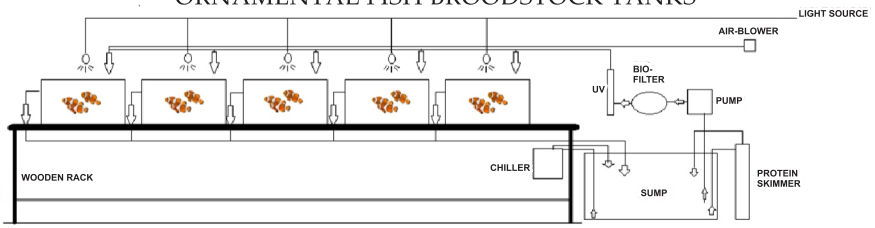
# Mini RAS (Recirculatory Aquaculture System) for broodstock maintenance in Marine Ornamental Fish Hatcheries

Aquarium keeping is a very popular hobby, the benefits of which have been recognised globally. It is a multi- billion dollar industry and it is estimated that globally around 1.5 -2 million people keep aquaria. Around 2000 species are traded annually including freshwater and marine ornamental fishes. About 1400 marine ornamentals are traded globally, most of which are associated with coral reefs or sea grass beds mangroves etc. Among the most traded families, Pomacentridae dominate with 43% of all fish traded, followed by Pomacanthidae, Acanthuridae, Labridae, Gobiidae, Chaetodontidae Callionymidae, Microdesmidae, Serranidae and Blennidae. India is sleeping giant in the global ornamental fish trade with vast untapped resources which could be effectively utilised to enhance our share in the global market.

The ever increasing demand for ornamental fish has necessitated the development of captive breeding techniques of these fishes and presently most of the popular fishes in the trade have been successfully bred in captivity. The main aspects of captive breeding techniques include brood stock development, larval rearing, live feed production etc. Among this broodstock development and maintenance is the most important thing. The brood stock of the fishes has to be maintained at optimum water quality conditions (Table 1) free from pathogenic organisms in order to condition them for breeding. This is possible by providing a Recirculatory Aquaculture System (RAS) in the hatchery. The Mandapam Regional Centre of ICAR CMFRI has devised a low cost technique for setting up of mini RAS for maintaining the brood stock of marine ornamental fishes. The basic components include the following:

1. A common sump
2. Biofilter
3. UV filter
4. Chiller
5. Protein skimmer
6. Blower
7. Inlet and outlet assembly for the fish tanks
8. Lighting arrangement for the fish tanks

SCHEMATIC DIAGRAM OF THE RAS - UNIT FOR MARINE ORNAMENTAL FISH BROODSTOCK TANKS




**Mini RAS set up at Mandapam RC of ICAR CMFRI**

Table-1. Optimum water quality parameters for marine ornamental fish brood stock development

| Sl.No | Parameter | Values |
|---|---|---|
| 1 | Temperature | 27-28 °C |
| 2 | Salinity | 30 – 35 ppt |
| 3 | pH | 7.5 - 8.5 |
| 4 | Dissolved Oxygen | > 5ppm |
| 5 | Ammonia | 0 ppm |
| 6 | Nitrite | 0 ppm |
| 7 | Nitrate | < 25 ppm |

## Operation of the mini- RAS

The basic objective of installing an RAS is to ensure the best water quality in the fish tanks apart from disinfection of the water to make it free from any pathogenic organisms. This aspect is taken care of here with the help of the various components of the RAS, which is described below:

The outlet pipes from all the fish tanks are connected to a common drainage pipe which in turn drains to the common sump. From the common sump, the water is passed through a biological filter followed by a UV filter using a pump and finally the purified water is fed to the individual fish tanks through separate inlet pipes. A protein skimmer and a chiller are also attached separately to the sump to maintain the water quality as well as to ensure optimum temperature in the water which is in circulation. The inlet pipes to the individual fish tanks are placed in such a way that the tip of the pipe reaches the bottom of the tank. This ensures proper mixing of the water in the tanks since the outlets are fixed at the top of the water column in the tank. Lighting is provided by installing CFL bulbs of suitable wattage above each tank which could be controlled by a timer to maintain the optimum photoperiod. Adequate aeration is maintained in the tanks with the help of a blower of sufficient capacity and aeration lines.

## Marine ornamental fish hatchery with a mini RAS (for broodstock) – Economics

**CAPTIAL COST**

| Sl.No. | Name of item/component | Qty | Cost (in Rs) |
|---|---|---|---|
| 1 | Chiller | 1 | 60,000.00 |
| 2 | Protein skimmer | 1 | 10,000.00 |
| 3 | Biofilter with pump | 1 | 15,000.00 |
| 4 | UV filter | 1 | 20,000.00 |
| 5 | Blower | 1 | 5,000.00 |
| 6 | Electrical and Plumbing works | LS | 25,000.00 |
| 7 | Glass tanks (3 x 1.5x 2 ft : LxBxH) | 16 | 64,000.00 |
| 8 | Wooden racks | LS | 75,000.00 |
| 9 | Larviculture tanks | LS | 2,50,000.00 |
| 10 | Shed and civil construction | LS | 5,00,000.00 |
| | **TOTAL** | | **10,24,000.00** |

**OPERATIONAL COST**

| Sl.No. | Item/component | Qty | Amount (Rs/year) |
|---|---|---|---|
| 1 | Cost of brooders | 16 pairs | 75,000.00 |
| 2 | Feed | LS | 2,00,000.00 |
| 3 | Electricity and fuel | LS | 25,000.00 |
| 4 | Labour (2x600x12) | 2 person | 2,40,000.00 |
| 5 | Other consumables | LS | 1,00,000.00 |
| | **TOTAL** | | **6,40,000.00** |

## INCOME GENERATION & ECONOMICS

**Assumptions:**

- Total no.of brooders – 16 pairs in 16 tanks
- No. of performing pairs in a month – 5 pairs twice a month
- No.of eggs/spawning - 200 no.s
- Survival = 70%
- Price of saleable size fish: Rs 100/piece
- Total eggs/month= 5 x 2 x 200 = 2000
- No. of fishes for sale= 70% of 2000 = 1400
- Sale price = 1400 x 100 = Rs 1,40,000/ month

**ECONOMICS OF THE UNIT – WITH OWN FUNDS**

| Particulars | Amount (Rs lakhs) |
|---|---|
| Revenue per annum | 16.80 |
| Total project cost | 16.64 |
| 1st year profit (16.80-16.64) | 0.16 |
| Profit from 2nd year onwards (16.8 - 6.4) | 10.40 |

**Economics of the unit- with Bank loan (for 5 year repayment period)**

| Sl. No. | Particulars | Amount (Rs. lakhs) |
|---|---|---|
| 1 | Total project cost | 16.64 |
| 2 | Revenue through sales | 16.80 |
| 3 | Operational cost | 6.40 |
| 4 | Net Revenue (less operational cost) | 10.40 |
| 1st year repayment | | |
| 1 | Interest on total project cost@12% | 2.00 |
| 2 | 1st year repayment part of principal amt | 3.33 |
| 3 | Total amount to be paid to bank in 1st year (int + ppl) | 5.33 |
| 4 | Net profit in 1st year | 5.07 |
| 2nd year repayment | | |
| 1 | Outstanding amount in bank | 13.31 |
| 2 | Interest on total project cost@12% | 1.60 |
| 3 | Principal amount | 3.33 |
| 4 | Total amount to be paid to bank in 2nd year (int + ppl) | 4.93 |
| 5 | Net profit in 2nd year | 5.47 |
| 3rd year repayment | | |
| 1 | Outstanding amount in bank | 9.98 |
| 2 | Interest on total project cost@12% | 1.20 |
| 3 | Principal amount | 3.33 |
| 4 | Total amount to be paid to bank is 3rd year (int + ppl) | 4.53 |
| 5 | Net profit in 3rd year | 5.87 |
| 4th year repayment | | |
| 1 | Outstanding amount in bank | 6.65 |
| 2 | Interest on total project cost@12% | 0.798 |
| 3 | Principal amount | 3.33 |
| 4 | Total amount to be paid to bank is 4th year (int + ppl) | 4.13 |
| 5 | Net profit in 4th year | 6.27 |
| 5th year repayment | | |
| 1 | Outstanding amount in bank | 3.32 |
| 2 | Interest on total project cost@12% | 0.40 |
| 3 | Principal amount | 3.32 |
| 4 | Total amount to be paid to bank is 5th year (int + ppl) | 3.72 |
| 5 | Net profit in 5th year | 6.68 |
| 6th year onwards | | |
| | Net profit (total revenue - operational cost) | 10.40 |