

- Pond culture
- Cages
- Pens enclosure
- Raceway
- Rope
- Raft
- Monoculture
- Polyculture
- Sewage fed culture
- Organic aquaculture

I) Traditional method

Pond culture

- Common method of fish culture
- Water is maintained in an enclosed area by artificial construction of dike/bund.
- Ponds are very small and shallow bodies of quiet standing waters with slight wind action.



Management Practices

Pond Preparation – There are various aspects in ponds preparation which should be carried out before pond is used for culture for first time & for subsequent crops. The main objective of pond preparation are to provide fish with a clean pond base & appropriate stable water quality.

- 1. Cleaning** – During fish production cycle considerable quantity of organic waste accumulates in pond bottom depending upon the cultural practices followed. Its waste must be removed to ensure sustain fish production from the pond. There are two methods –
 - a. Dry method** – In this method, after the final harvest the pond bottom is dried and crack developed primarily to oxidize the organic components, left over in the pond after the previous culture. The pond bottom should be dried for at least 7-10 days & the soil should crack to a depth of 2.5 – 5.0 cm. After drying the pond bottom is ploughed up to a depth of 15 cm.
 - b. Wet method** – In this method, after the final harvest, the accumulated organic matter at pond bottom is flushed out in form of a thin slurry using a heavy duty pump.

Nutrient profile of some common manures & fertilizers

Sl. No.	Manures/fertilizers	N %	P %	K %
Manures of animal origin				
1.	Raw cow dung (RCD)	0.6	0.16	0.45
2.	Pig Dung (PD)	0.6	0.45	0.50
3.	Duck droppings	1	1.4	0.62
4.	Poultry excreta	1.6	1.5 - 2	0.8
Manures of plant origin				
1.	Mustard oil cake	4.5	2.0	1.0
2.	Ground nut)	7.8	1.5	1.3
3.	Mahua oil cake	2.5	0.8	1.8
Inorganic				
1.	Urea	43-46		
2.	Ammonium nitrate	20.5		
Phosphatic				
1.	Single Super Phosphate(SSP)		16-20	
2.	Triple Super Phosphate (TSP)		40-45	
Potash				
1.	Muret of Potash			48-62
2.	Sulphate of Potash			47-50

Recirculating Aquaculture system (RAS)

A Recirculating Aquaculture System (RAS) can be defined as an aquaculture system that incorporates the treatment and reuse of water with less than 10% of total water volume replaced per day.

- The main benefit of RAS is the ability to reduce the need for fresh, clean water while still maintaining a healthy environment for fish.

Bio-filtration

Solids removal

Solids are flushed out or vacuumed out manually using a siphon

Oxygenation

- Dissolved oxygen levels can be increased through two methods aeration and oxygenation. In aeration air is pumped through an air stone or similar device that creates small bubbles

pH control

↓ pH leads to ↑ CO₂

pH is controlled by :

- addition of lime (CaCO₃) or sodium hydroxide (NaOH).
- degassing CO₂ in a packed column or with an aerator

Simplified Process Flow Diagram for Recirculating Aquaculture Systems (RAS)

1

Grow-Out Tank

These are the large culture tanks where fish (or shellfish) are raised.



2

Solids Removal

Solids, such as fecal material and uneaten feeds are removed by mechanical filtration.



3

Biofiltration (Ammonia Removal)

Beneficial bacteria consume ammonia, which, converted into nitrogen, is released harmlessly into the atmosphere.



4

Dissolved Gas Control (Oxygenation)

The final step, and the most crucial for the fish, is to reoxygenate the culture water as it returns to the grow-out tank. Pure oxygen is injected to the returning water. Carbon dioxide is also removed.

Recirculated Water "In"

Recirculated Water "Out"

Recirculated Water "Out"

Fish Wastes & Uneaten Feed

Advantages

- **Reduced water requirements** as compared to raceway or pond aquaculture systems.
- **Reduced land needs due to the high stocking density.**
- **Site selection flexibility** and independence from a large, clean water source.
- **Reduction in wastewater effluent volume.**
- Ability to closely monitor and control environmental conditions to maximize production efficiency. Similarly, independence from weather and variable environmental conditions

Cage culture

- Rearing of fish from juvenile stage to commercial size in a volume of water enclosed on all sides.
- Cage culture is suitable to water areas which cannot be drained.
- Cages of metal, bamboo, mesh or nylon mesh are left in flowing water
- Used for salmon, Trouts, Yellow tail, Sea bass, Murrels.
- Cage culture originated in Kampuchia 200 years ago



Types and layouts of cage farms

1. Floating type of cages
2. Submersible type of cages

Floating type cage

Consist of:

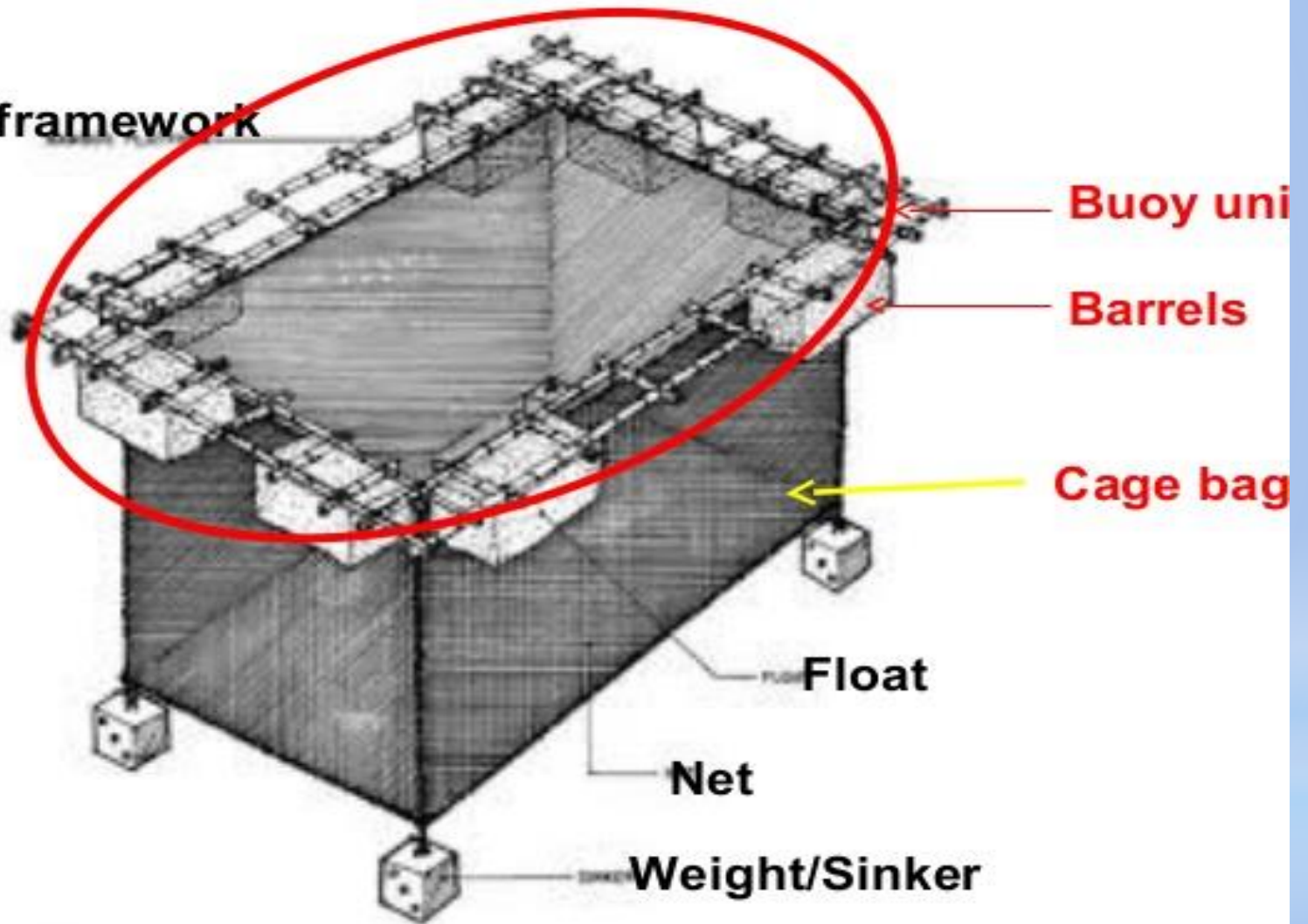
1. **Floating unit** in the form of a framework and

- Floating unit contains empty barrels, styrofoam polythene pipes or pontoons of plastic.
- Floating units are built into framework impregnated with wood, bamboo spars, Al bars.

2. **Flexible mesh net cage bag** suspended under it.

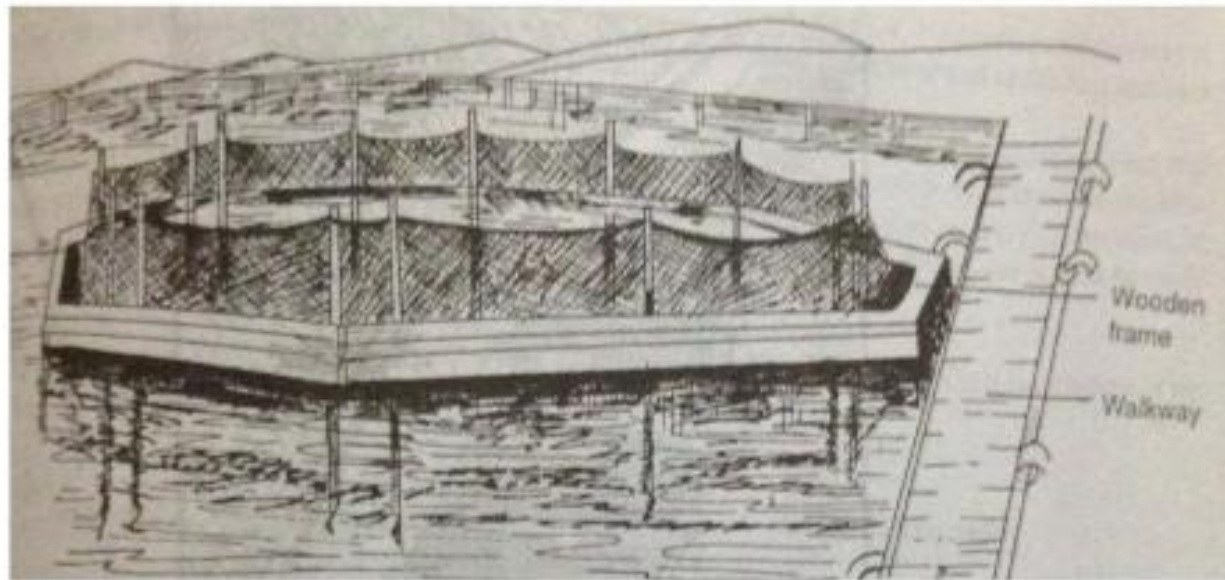
- Net is commonly made up of Nylon.
- Cages of under water net volume of 200 and 500 m³ are preferred.
- It is common practice to have **double netting: outer for predators** and **inner for fish stock**

Bamboo framework

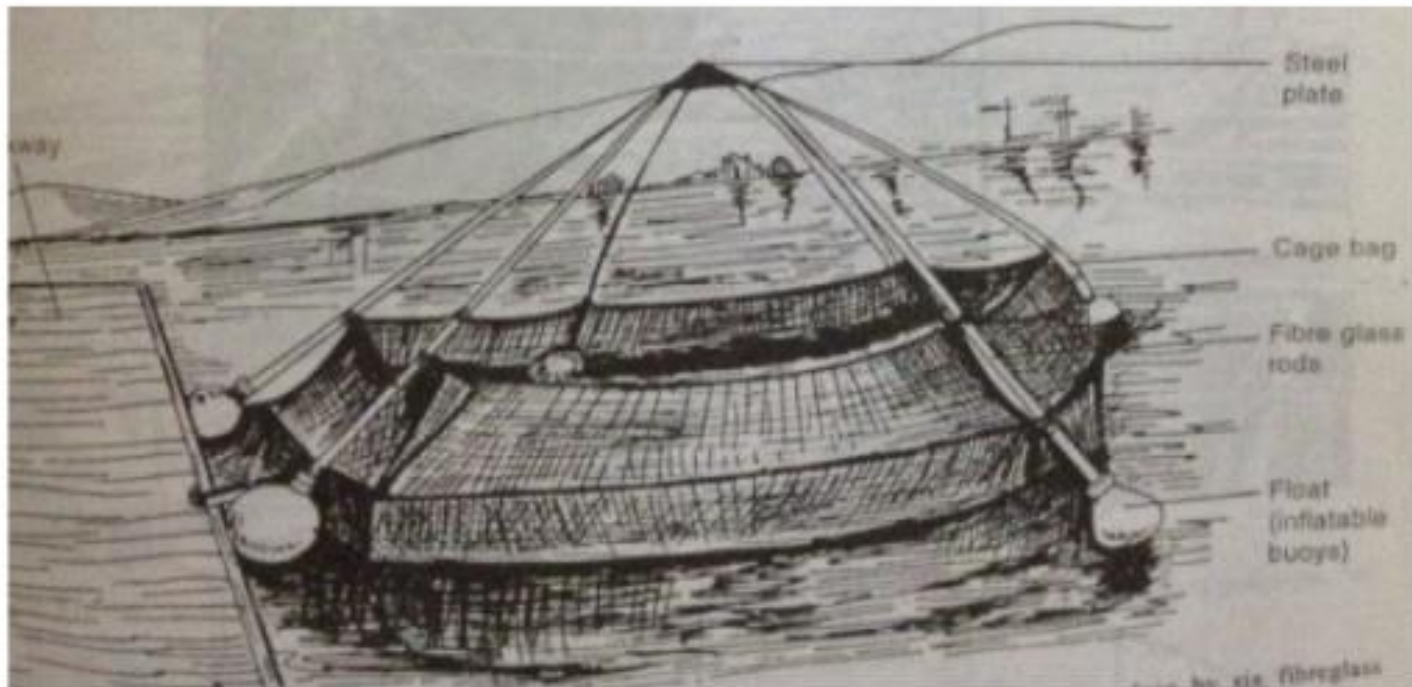


Floating cage structure

- When timber is used as framework, 6 or 8 sided structures are made.
- Such cages are linked together by flexible joints.



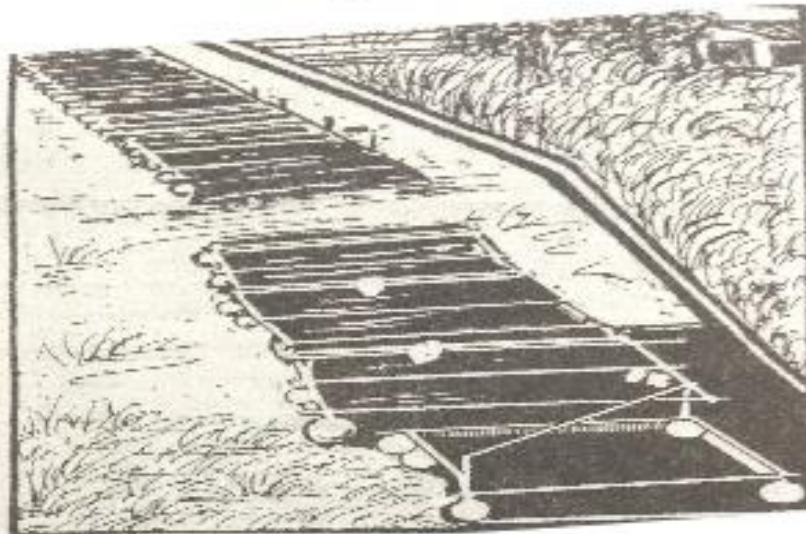
Hexagonal Floating cage with wooden framework



Six sided floating cage (six inflatable rubber buoys are used and kept in place by six fiberglass poles radiating from a steel plate above the cage, looking like inverted umbrella

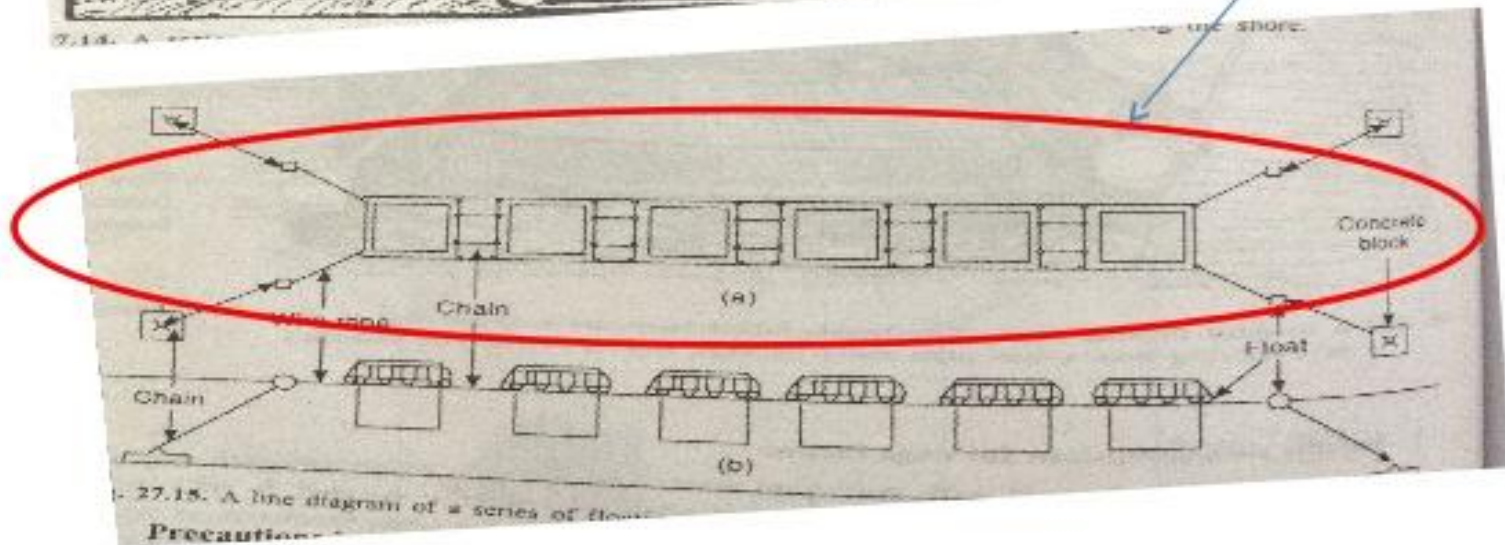
A nylon net is stretched between the laths to prevent leaping fish from escaping.

Arrangements of floating cages



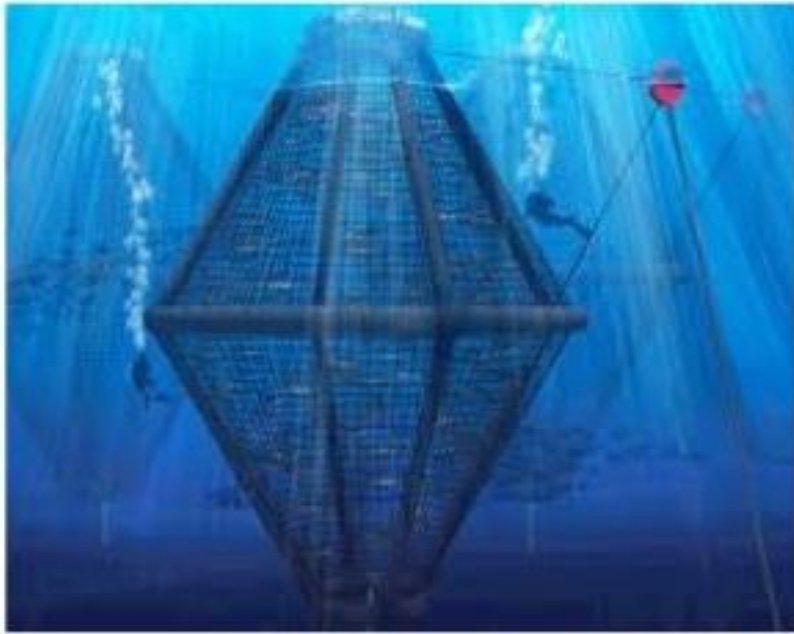
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Top View

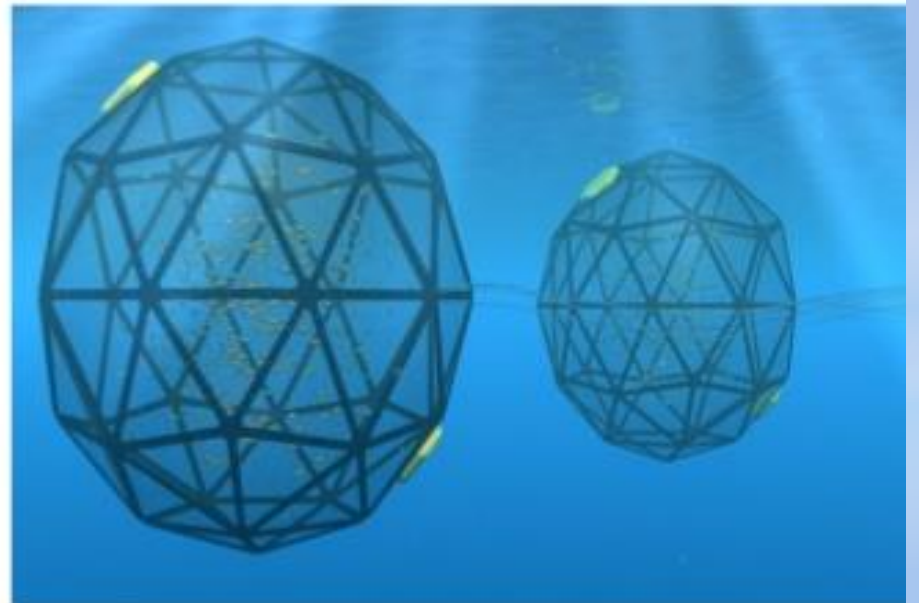


Submersible type of cage

- Generally used in areas subjected to typhoons and cyclons.
- Used in Japan for **yellow tail rearing**.
- Can withstand the wind and waves.
- The shape of cage is maintained by attaching weights of upto 10 kgs at each corner of cage bottom.
- Cage can be lowered or raised in water using ropes.



Submerged cage





Spindle shaped submersible cage

In hurricane affected areas, **Spindle-shaped** collapsible net cages are used. These cages are held in position by circular PVC rings of different diameters.

Under normal conditions, the cages float on the surface but when cyclones or tycoons occur, they **can be sunk to the bottom** by increasing the weights or removing floats

Suitable sites/ conditions for cage farms

- Areas with sufficient movement of water for adequate mixing and aeration.
- Polluted sites are avoided.
- Cages should be installed in the sides of central walkway to facilitate day to day work on the farm.

Advantages of cage farming

1. Fishes can be stocked at **high density rate**.
2. Enclosed fishes are **protected from predators**
3. Water flowing through the cage brings food supply and carries away water.
4. Management and capital investment is less.
5. Effective use of existing water bodies
6. Technically simple
7. Easier stock management and monitoring

Disadvantages

- Cages occupy a space (can disrupt access to navigation), reduce land value.
- Increase sedimentation rate.
- Can introduce diseases
- Uneaten food affect water quality