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e- Learning lessons on
How to do fish farming through bio-floc technology?

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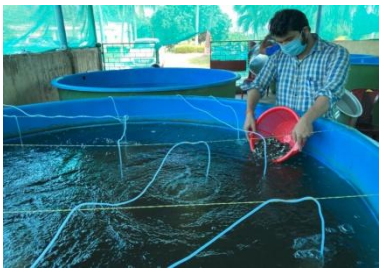


Preface

Biofloc technology (BFT) is a highly advanced aquaculture approach that emphasizes the continuous recycling and reuse of nutrients in culture systems, reducing the need for water exchange. This eco-friendly method relies on *in-situ* microbial protein production by manipulating carbon and nitrogen levels in water. Biofloc refers to the suspended growth in water, comprising living and dead organic matter, phytoplankton, bacteria, protozoa, and grazers of bacteria. Biofloc systems serve a dual purpose by providing food resources for cultured organisms and acting as a water treatment solution. They are also known as active suspension ponds, heterotrophic ponds, or green soup ponds. One of the key advantages of biofloc farming is its space efficiency; biofloc tanks can be constructed even on rooftops, making it suitable for urban aquaculture promotion. The productivity of biofloc systems is impressive, with the potential to produce 400-500 kg of fish in a 0.16 ha pond over a year achievable in a 10,000-liter biofloc tank in just 4-5 months. Furthermore, biofloc farming is associated with fewer issues related to poaching, poisoning, and predation compared to traditional pond fish farming. It also reduces the need for supplementary fish feed by more than 50%. Moreover, excess bioflocs can be converted into high-quality bio-fertilizers for nutritional kitchen gardening or used as feed for other fish species. When implemented scientifically, biofloc farming has the potential to significantly contribute to meeting global animal protein demands.

Authors

Content

Materials required for bio-floc farming

- **Tank:** The tank can be circular or rectangular. Circular tanks offer better water circulation and minimize the formation of 'dead zones,' but they make fish harvesting more challenging. Rectangular tanks, on the other hand, facilitate easier fish harvesting but are more prone to 'dead zone' formation.
- **Water:** High-quality, iron-free water is essential. Rainwater and tube well water can be used after treatment, but pond water is not recommended.
- **Thermometer:** A thermometer is necessary to monitor water temperature.
- **Aeration equipment (air pump, air pipe, air stones, etc.):** These are required to supply oxygen to the water.
- **pH meter:** This is essential for monitoring the pH of the water.
- **Salinity or TDS meter:** This is necessary to measure the salinity of the water.
- **DO meter:** A DO meter is used to measure the dissolved oxygen (DO) level in the water. If a meter is not affordable, a DO kit can be used instead.
- **Weighing machine:** A weighing machine is needed to estimate the requirement of materials such as probiotics, salt, molasses, etc., accurately.
- **Ammonia testing kit:** Used to estimate the ammonia level in the water.
- **Nitrite testing kit:** Used to estimate the nitrite level in the water.
- **Nitrate testing kit:** Used to estimate the nitrate level in the water.

- **Alkalinity testing kit:** Used to estimate the total alkalinity level of the water.
- **Iron testing kit:** Used to estimate the iron level in the water.
- **Imhoff cone with stand:** Used to estimate the volume of floc in the water.
- **Non-iodized salt:** Used to maintain TDS/salinity levels in the water.
- **Probiotics:** They are needed for the preparation of Fermented Carbon Organic (FCO). They supply beneficial bacteria that catalyze the breakdown of ammonia. Heterotrophic bacteria-rich probiotics are preferred over autotrophic bacteria-rich probiotics.
- **Carbon (C) supplements:** These are needed for Carbon-Nitrogen balancing. Sugar (42% C), Jaggery (25-30% C), Molasses (22-25%) etc., can be used as carbon supplements. Molasses is a common choice.
- **Lime:** Lime is necessary for correcting pH levels. Calcium carbonate is preferred over calcium oxide as a liming material.
- **Fish feed:** Floating feed is preferred over sinking feed. A feed with 25-30% CP (Crude Protein) is sufficient. Sinking feed is typically used for prawn farming.
- **Fish medicines/sanitizers:** These are necessary for fish prophylaxis and therapeutics, tank sanitization, bio-security measures, etc.
- **Other materials:** Buckets, bowls, nets, beakers, trays, threads, ropes, etc., as well as a dedicated power supply system, are also needed.

pH & TDS meter

Weighing scale with bowl

DO meter

Air pump (ACO 006-010)

HAP 120

Air pipes

Air stones

Imhoff cone with stand

Ammonia test Kit

Nitrite test Kit

Probiotics (Brand: Everfresh Pro)

Probiotics (Brand: Fish Vigyan)

Jaggery

Sugar

Molasses

Floating feed

Sinking feed

Water quality parameters for bio-floc fish farming

Water temperature	27-32^{0}C
Dissolved Oxygen	>5.0 mg/litre
Salinity	0.5-1.5 g/litre
TDS	500-1500 mg/litre
Total alkalinity	>75 mg/litre
Ammonia-N	<1.0 mg/litre
Nitrate	<10 mg/litre
Nitrite	<0.5 mg/litre
Iron	<0.3 mg/litre
Floc density	20-40 ml/ litre

The better the water quality, the fewer problems with ammonia and fish diseases.

Readymade bio-floc tank (5000 litres)

Cemented tank

Low-cost rectangular bio-floc tank

Tank preparation

- Rub the tank surface with a potassium permanganate solution (5 mg/litre) or any soap/detergent.
- If the tank is made of cement (pH 11.0), it needs to be '**cured**' for a week with potassium permanganate (5 mg/L) or tamarind water (250 g/L) to stabilize the pH.
- Flush out the rubbed surface with water and let it dry (for 1-2 days).


Tank preparation

Water preparation

- Fill 2/3rd of the tank with iron-free water and aerate it for 2-3 days.
- Add non-iodized salt to correct the salinity/TDS; approximately 10.0 kg of salt is needed to correct the TDS of 10000 liters of water.
- Adjust the pH. To increase the pH level, add lime (100 mg/litre). To decrease the pH, add a weak acid (such as vinegar) or tamarind/lemon water.
- Aerate the water for another 4-5 days.

Iron removal from water by vigorous aeration followed by settling for a week (iron content in water should be <0.3 mg/L)

Iodized salt or non-iodized salt!

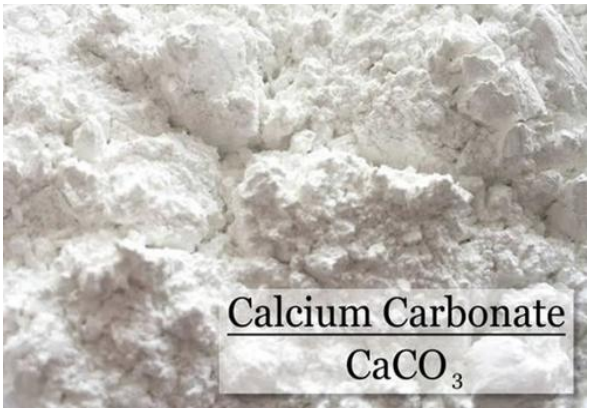
- Iodine is toxic to fish and other aquatic life; therefore, non-iodized salt is preferable over iodized salt.
- **Sublimation** is a process by which iodized salt can be converted to non-iodized salt by boiling.
- For disease treatment, iodized salt is preferable.

Non-iodized salt

Iodized salt

Quicklime or Calcium Carbonate!

- Quicklime causes a sudden pH jump to 12.4, increasing the risk of accidents, as the alkaline death point is 11.0.
- In contrast, calcium carbonate raises the pH to a maximum of 9.6, resulting in a lower risk of accidents.



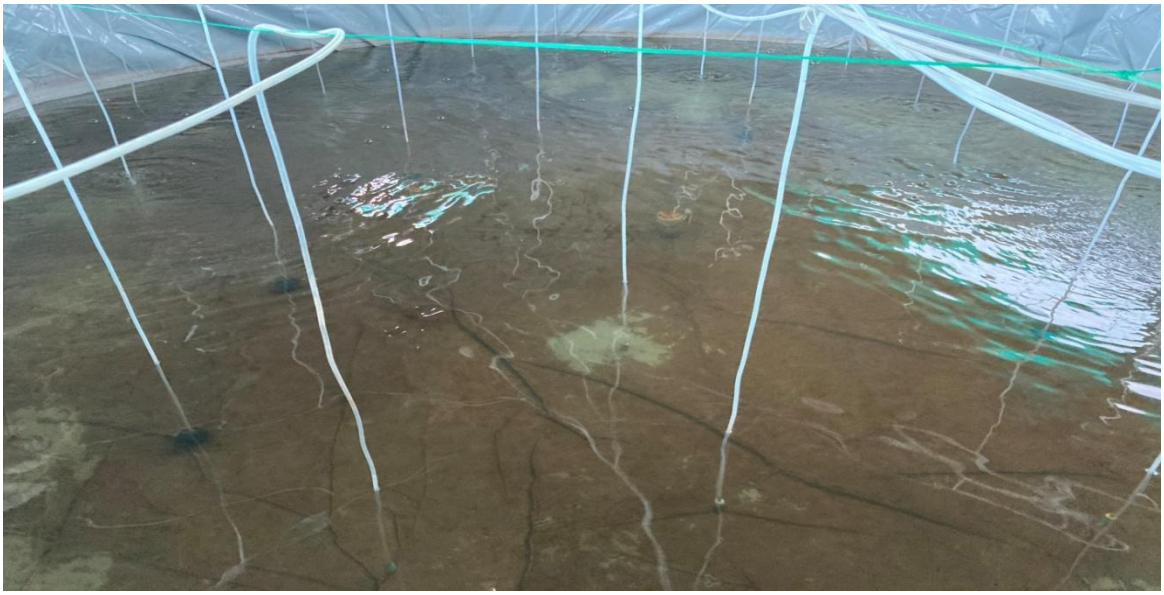
Preparation of <u>Fermented Carbon Organic (FCO)</u>

- Take a 100-liter bucket and fill it with 20 liters of water.

- Add 400 g of probiotics and 800 g of molasses to the water.
- Mix in some salt (100-200 g) thoroughly.
- Cover the bucket, making a small 5 mm hole in the cover for aeration.
- Set the concoction on aeration for 4-5 days or until froths/flocs appear.
- Transfer the FCO into the biofloc tank and wait for another 5-7 days until floc formation occurs.

FCO preparation

Transferring FCO into the bio-floc tank



The formation of a brown chocolate layer at the bottom of the biofloc tank after 5-7 days indicates that the tank is ready for fish stocking.

Fish stocking

- Stock fish when floc density reaches 10-20 ml/1000 litres.
- Monoculture is preferred.
- Use good-quality fish seeds (1000-1200 lines) stocked at 1 fish/2 liters of water.
- Ensure all seeds are from the same age/source when stocking.
- Fish suitable for biofloc systems include *Koi, Tilapia, Singhi, Magur, Pabda, Tengra, Pangas*, etc.
- Properly sanitize the fish seeds before stocking them into the tank.

Koi fish (800-1000 lines; 800-1000 fish seeds /kg)

Singhi (1000-1200 lines; 1000-1200 fish seeds /kg)

Fish stocking

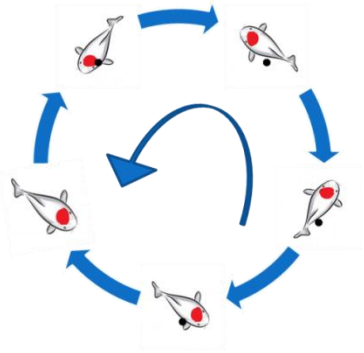
Tengra

Pabda

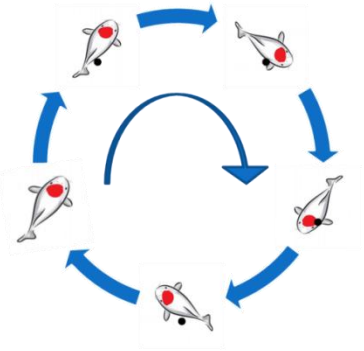
Low TDS demanding fish (250-500 ppm)

Among the carps, farming of Common carp and Rohu is possible in biofloc tanks

How to differentiate good quality fish seeds from bad ones?

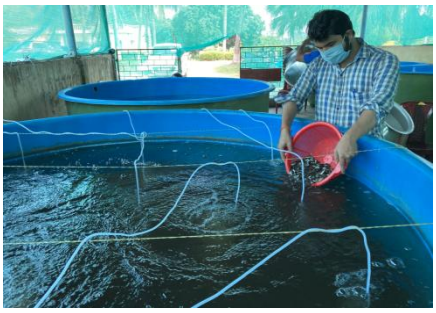


Good quality fish seeds move against the water flow



Bad fish seeds move with the water flow

How to transport fish seeds?



Fish seeds can be sanitized by immersing them in a potassium permanganate ($KMnO_4$) solution at a concentration of 5 mg/L for a duration of 1 minute.

Fish sanitizer

Sokrena®-WS (Virbac) (Dose: 100 ml/1000 litres of water)

Feed supply

- Start supplementary feeding 24 hours after stocking fish with floating pellet feed.
- Ensure the feed has a protein content of 25-30%.
- Use feed sizes appropriate for the mouth of the fish seed.
- Feed fish in the morning (when their enzymatic activity is high).
- Initially, feed at a rate of 2% of the fish body weight and gradually reduce it to 1%.
- Avoid using dust feed.

Amoxycillin

Oxytetracycline

The fish feed fortification technique involves spraying a medicinal solution onto the feed, with a ratio of 1 tablet of antibiotics or vitamins per 1 kg of feed.

Carbon supplementation

- After started feed supplementation, the ammonia level in the tank water will begin to rise.
- The target is to restrict the ammonia level to ≤1 mg/litre, through carbon-nitrogen balancing.

- Test the water's ammonia level (using a kit), and for every 1 mg/litre ammonia level increase, add 200g of sugar or 300g of jaggery.
- Initially, keep the C/N ratio at 15:1, then gradually reduce it to 12:1, and finally to 10:1 in the last phase of culture.

Ammonia, Nitrite, Nitrate test (API kit)

Disease management

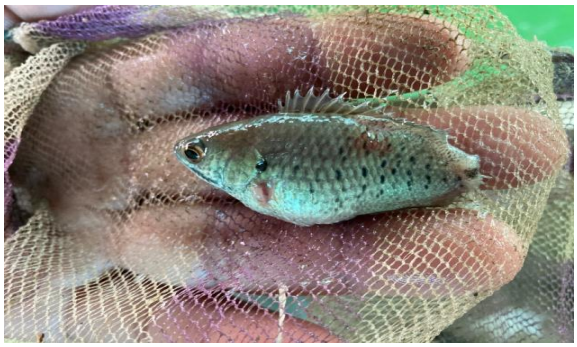
The likelihood of fish diseases is higher in biofloc systems due to the high-density farming.

Preventive measures

- Adding 2% Haldi (turmeric) or Ashwagandha powder in feed improves the immunity and disease resistance capacity of fish.
- Provide Zinc Tablet, Vitamin C Tablet, and B-complex Tablet at a rate of 1 tablet per kg of feed to improve fish immunity.

Curative measures

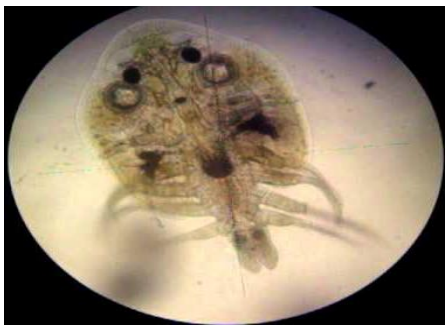
- Separate the diseased fish and transfer them to a 'Hospital tank.'
- Identify the cause of the disease (whether bacterial, fungal, or parasitic).
- For bacterial diseases, use potassium permanganate (5-10 mg/litre), enrofloxacin (20 ml/kg feed), oxytetracycline, or amoxicillin (10 mg/kg feed).
- For fungal diseases, use formalin (20 ml/litre), CIFAX (0.1 ml/litre), or fluconazole (150 mg/100g feed).
- For parasitic diseases, use sodium hydroxide/common salt (5g/litre).
- Avoid applying antibiotics and formalin directly into the tanks, as they will kill all the flocs.



A typical bacterial infection (tail rot)

Fungal Infection in Singhi seedling

Fungal Infection



Argulus infestation

Parasitic infections are less in bio-floc tanks

Indigestion/ bloated stomach: Liver tonic say "Liv-52" can be supplemented in fish feed (@10-20 ml/kg feed)

Nutrition deficiency of Koi seedling

Nutrition deficiency

Red spot on fish head

Fungal infection remedy: Fluconazole 150mg

1 pill / 1000g of feed

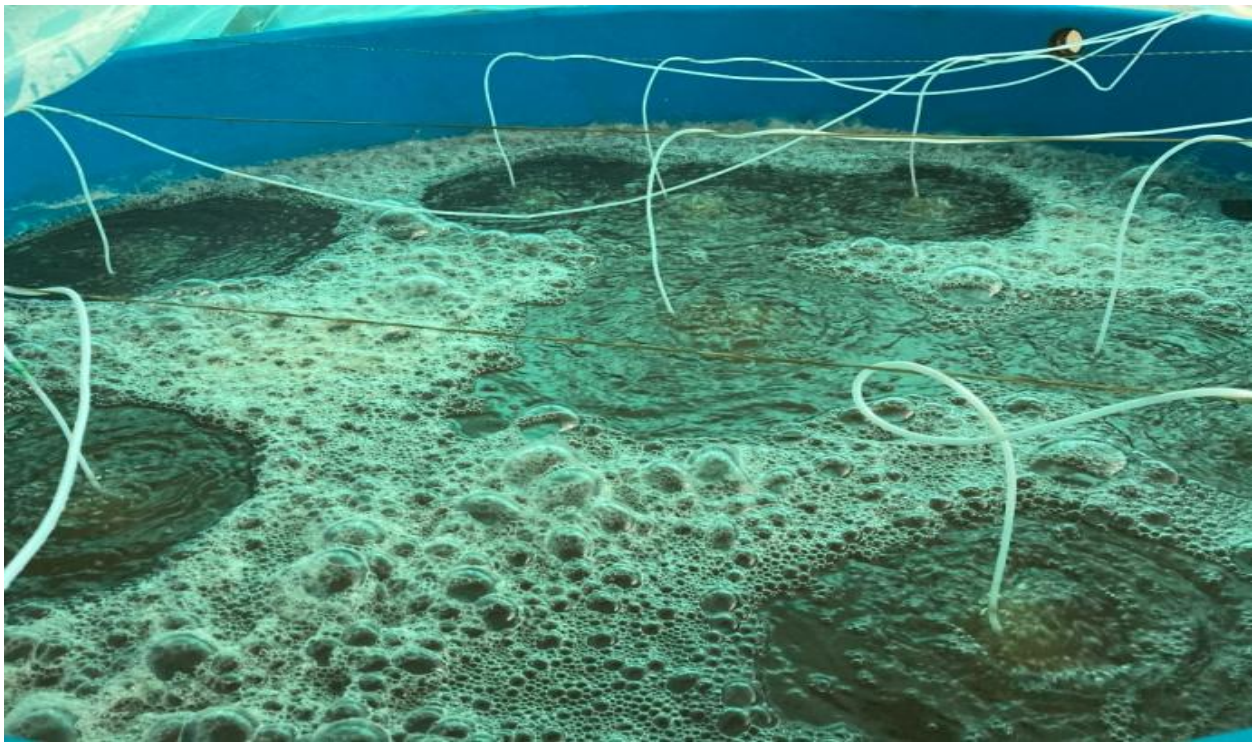
Management related issues

Not controlling ammonia : Fading of gill, destruction of chloride cell, and impairment in osmoregulation leading to mortality

Not maintaining proper dissolved oxygen leads to hypoxia and fish-kill

Tilapia in particular needs high dissolved oxygen (≥6 mg/L)

Excess oxygen supply leads to pop eye/ Exophthalmia like condition in fish



'Protein froth' formation in case dead fish are not removed from the tank

Excess flocs lead to problem of nitrite and

Strain out excess flocs time to time with the use

nitrate, foul smell & fish-kill

of a plankton net

Eco-Marine/ Bio-Marine (Virbac) removes foul smells (8-10 tablets/ 10000 litres tank)

Microlife S2, helps in the completion of

Floc management

nitrogen cycle and minimize the toxicity of Nitrite (Dose: 100 ml/1000 litre) [Available in www.amazon.in]

Floc management

- Maintain an ideal floc density of 20-40 ml per 1000 liters of water.
- If the density exceeds 40 ml, consider exchanging 25-30% of the water or strain out some flocs using a plankton net.
- Sometimes, the floc density may drop below 20 ml, especially after 3-4 months of culture. In such cases, 'boost' the tank water by adding Fermented Carbon Organic (FCO).

Other management

- Regularly check the efficiency of the air pump, air pipes, air stones, and regulators.
- Clean air stones by dipping them into an acid solution (such as hydrochloric acid) or Harpic solution if needed.
- Ensure provision for inverters or generator service as a backup to tackle problems related to power outage.

Harpic solution cleans air stones

Waste management

- Biofloc farming generates a large amount of 'sludge' (1000-1500 liters per 10000-liter tank).
- This sludge is rich in nutrients and can be used as a high-quality fertilizer for nutritional kitchen gardening or fodder production.

- Diluted sludge can also be used to fee coprophagous fish like Common carp and Mrigal.

Sludge

Floc fertilizer

Fish feed made with biofloc

Winter management

- ✓ Avoid biofloc farming during the winter months (December-January).
- ✓ During this time, the fall in water temperature leads to slower multiplication of probiotics, making it difficult to control ammonia levels.
- ✓ Fish diseases are more prevalent in winter due to a decrease in fish immunity.
- ✓ If you still want to run the system, consider some Do-it-yourself (DIY) methods:

  - Surround the tank with a polythene sheet (200-300 GSM) to create a house or pandal like structure.

  - Hang some 200W bulbs (4-5 per 10,000-liter tank).

  - Immerse 500W water heaters (2-3 per 10,000-liter tank).

Winter management

Fish harvesting

- Partial harvesting is preferred over complete harvesting.
- A triangular net can be used for harvesting.

Low-cost innovative hand nets

Fish production from bio-floc tank (10000 litres)

Fish	Stocking (nos. /tank)	Avg. weight (g)	Survival (%)	Production (kg/tank)
Tilapia	3500	100	90	315
Koi	5000	80	90	360
Singhi	8000	40	80	256
Pabda	5000	60	85	255
Tengra	5000	50	85	213
Common carp	3000	150	80	360
Pangas	1500	400	85	510
Murrel	4000	100	75	300

Mono-sex Tilapia

Koi (Vietnamese)

The highest size recorded at ICAR Tripura Centre (156 g)

Economics of bio-floc farming

- The setup cost for a 10,000-liter biofloc tank is Rs. 50,000-60,000/-.
- The total expenditure for running a cycle of fish farming is Rs. 30,000-35,000/-.
- The total expenditure is Rs. 80,000-95,000/-.
- Fish production expected from the system in a cycle is 200-300 kg over 4-5 months.
- At a selling price of Rs. 300 per kg (for koi fish), the total benefit obtainable is Rs. 60,000-90,000/- with a benefit-cost ratio of 2-3.

Economics of bio-floc farming

Sl. No.	Component	No.	Cost (Rs.)	Total (Rs.)
Capital Cost				
1.	Tank construction with Tarpaulin (10000 litres)	1	20000.00	20000.00
2.	Air Pump (ACO 008)	1	6000.00	6000.00
3.	Air pipe, air stones and other accessories		2000.00	2000.00
4.	pH meter and TDS meter	1 each	1000.00	1000.00
5.	Imhoff settling cone	1	1500.00	1500.00
6.	Alternate power supply (Inverter)	1	25000.00	25000.00
7.	Miscellaneous expenses (electrification,		5000.00	5000.00

	logistics, shade etc)			
	Total			60000.00

Operation expenditure

Sl. no.	Component	Nos.	Cost (Rs.)	Total (Rs.)
Operational cost (5-6 months)				
1.	Fish seed (say Koi)	5000 nos.	2.5/-	12500.00
2.	Fish feed (25-30% CP)	300 kg	50/-	15000.00
3.	Probiotics, molasses, lime, raw salt etc			5000.00
4.	Water testing kit (NH_3, NO_2, DO etc)	2 sets	2500.00	5000.00
5.	Miscellaneous (logistics, medicines, net etc)			2500.00
	Total operational cost			40000.00
	Total benefit	250 kg fish	300/-	75000/-
	Net benefit			35000/-

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