WORKSHOP & TRAINING (RESIDENTIAL)

THE INDIAN FRESHWATER FISHERIES SECTOR

How to scale up preventive approaches to minimise antibiotic use

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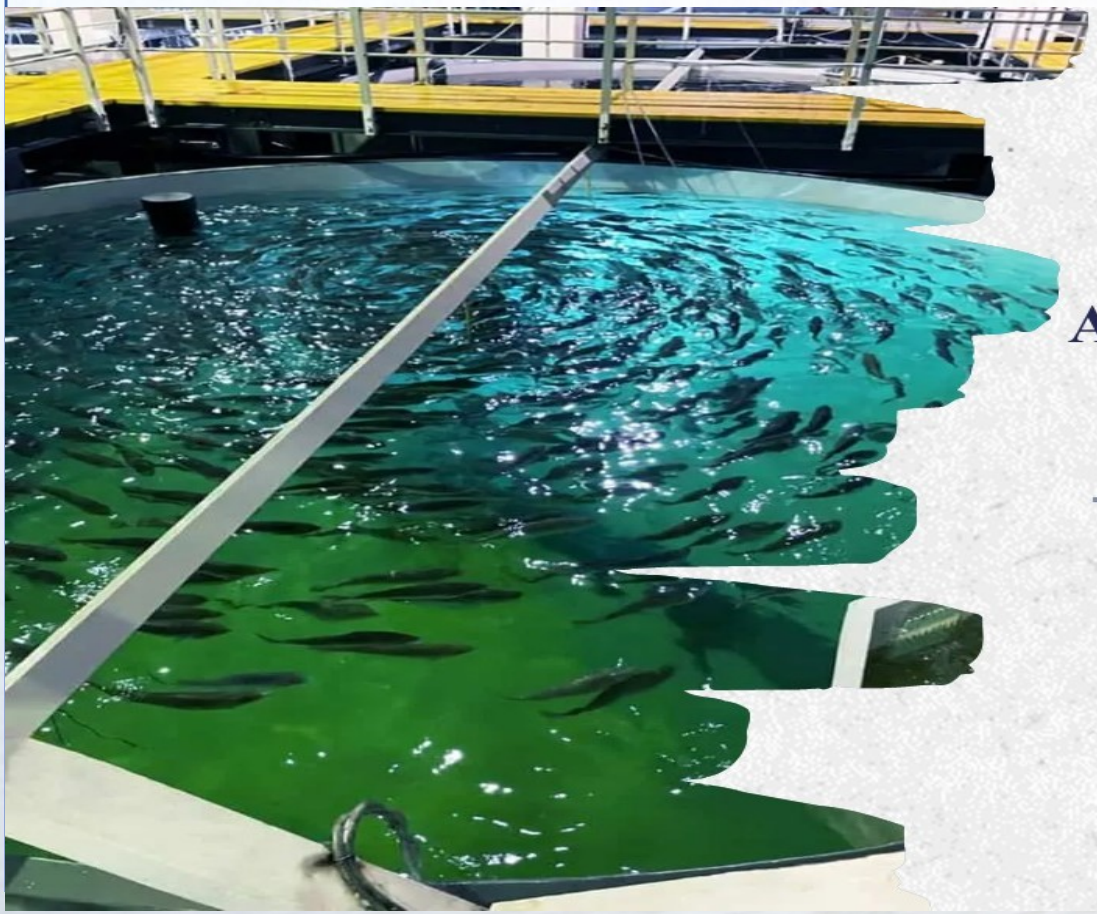


CHALLENGES AND POSSIBILITIES OF SCALING UP RE-CIRCULATORY AQUACULTURE SYSTEM: PERSPECTIVE FROM UTTAR PRADESH

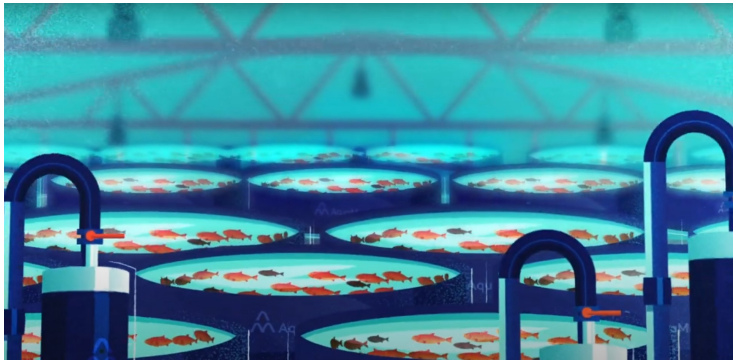
Dr. Mukta Singh

Assistant Professor,
Department of Aquatic Animal Health Management
College of Fisheries Science, DUVASU, Mathura

Recirculating Aquaculture System

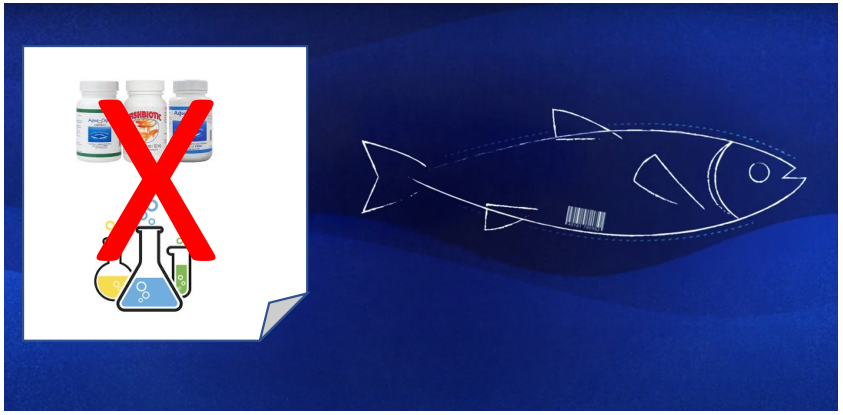
- **The Recirculating Aquaculture System (RAS)** has gained significant attention due to its capacity for sustainable production of high-quality protein, while minimizing the environmental impact.
- RAS is striving to reduce water consumption and discharge, with some aiming for almost zero water discharge to facilitate land-based production and proximity to markets.

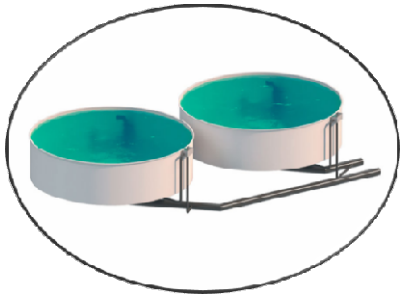
Advantages of RAS



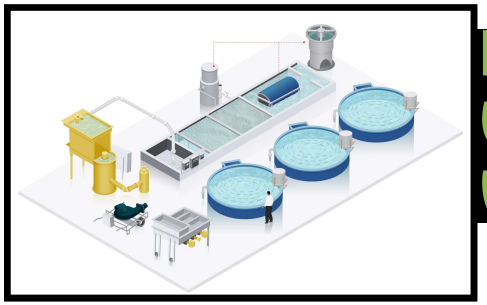
In **RAS**

- Fish are cultured inland in a closed system.
- These facilities provide a controlled, safe and traceable environment
- Free from antibiotics and chemical





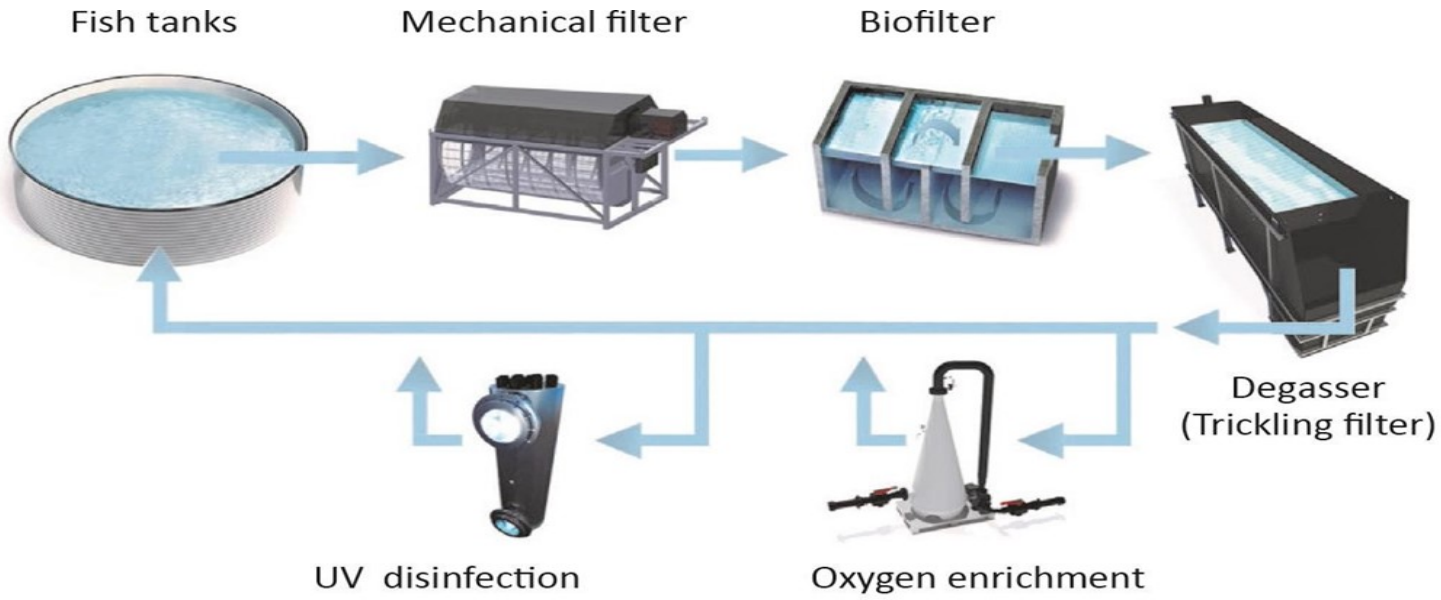
What is RAS ?



- **Recirculation aquaculture System** is essentially a technology for farming fish or other aquatic organisms by reusing the water in the production.
- The technology is based on the use of mechanical and biological filters, and this principle can be used for any species grown in aquaculture such as **Fish, Shrimps, Prawns.**
- **Recirculation** can be carried out at different intensities depending on how much water is recirculated or re-used.
- Seen from an environmental point of view, the limited amount of water used in recirculation is of course beneficial as water has become a limited resource in many regions.
- Controlling parameters such as water temperature, oxygen levels, or daylight for that matter, gives stable and optimal conditions for the fish & Shrimp, which again gives less stress and better growth**.**

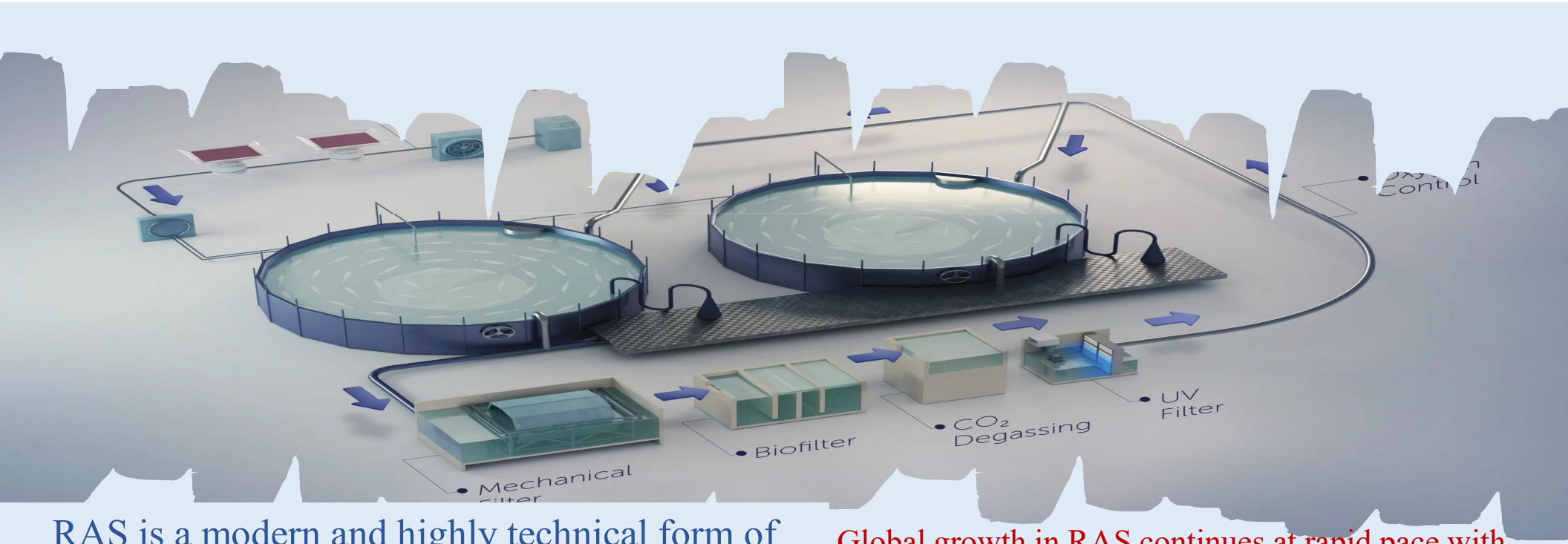
RAS DEVELOPMENT

The basic **RAS** consists of mechanical filtration, biological treatment and aeration/ stripping. Further installations, such as oxygen enrichment or UV disinfection, can be added depending on the requirements.



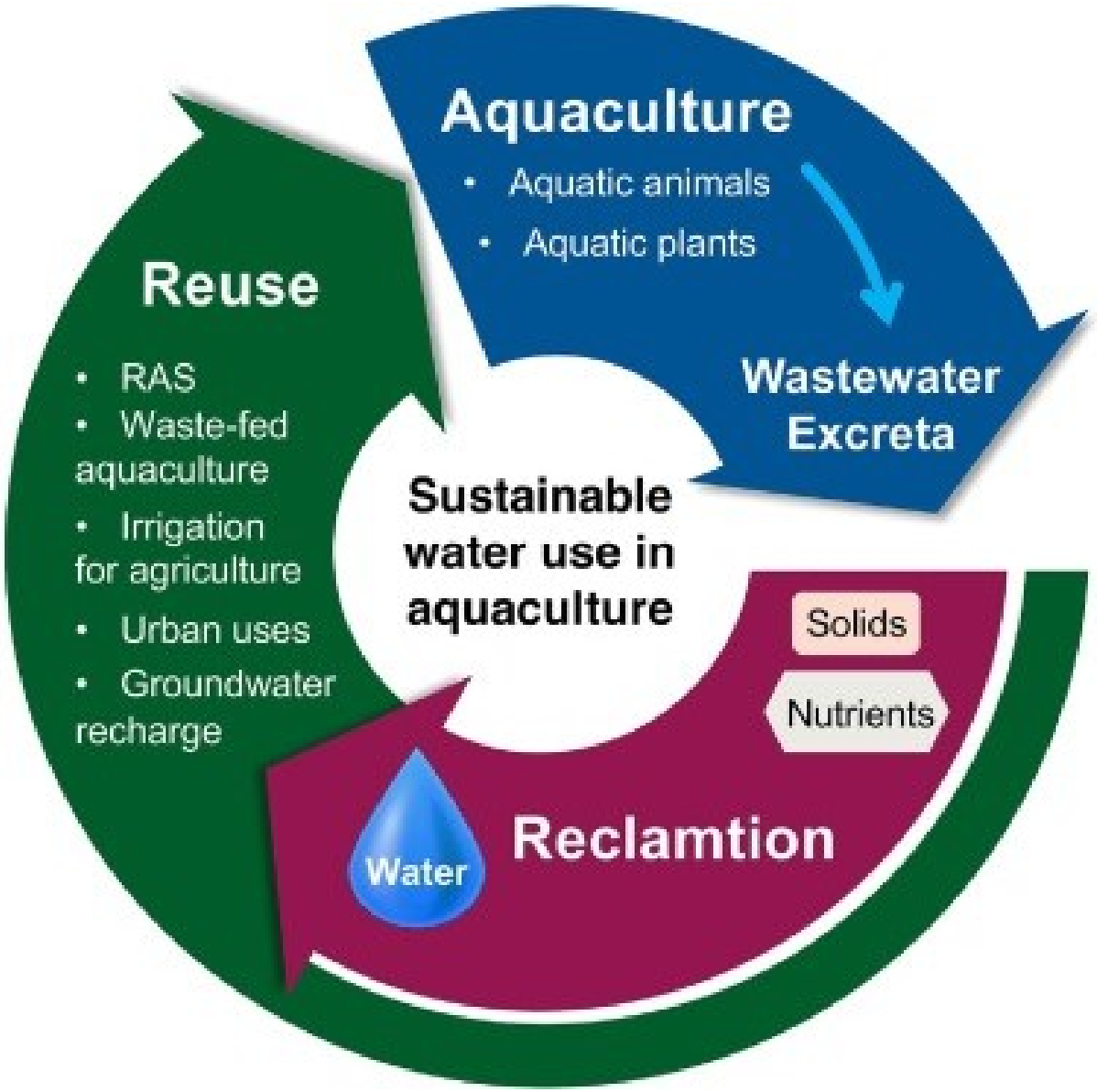
Why water need to be circulated ?

The limited use of water makes it much easier and cheaper to remove the nutrients excreted from the fish as the volume of discharged water is much lower than that discharged from a traditional fish farm. Recirculation aquaculture can therefore be considered a most environmentally friendly way of producing fish at a commercially viable level..

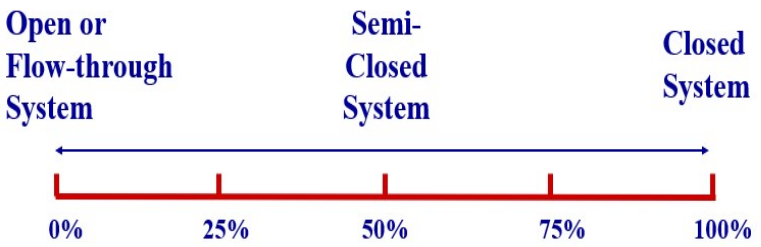


RAS is a modern and highly technical form of aquaculture, which uses indoor tank systems to grow fish in a more controlled environment.

Global growth in RAS continues at rapid pace with systems being built capable of producing 5 to 120 thousand tones per year.



Water Reuse Rates



Recirculatory Aquaculture System (RAS) Need of the Hour in Aquaculture Industry

High biosecurity

•Minimal environmental pollution

Very low water requirement (90–99% reuse)

Compliance with environmental regulations

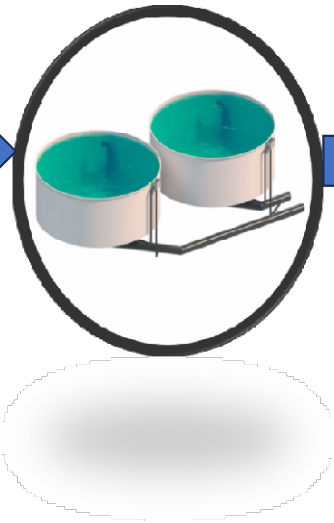
•High stocking density & productivity

Year-round, climate-independent production

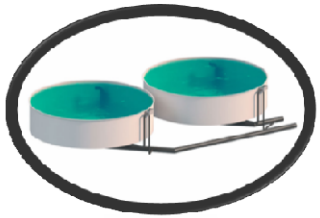
Better feed efficiency and growth control

Suitable for urban and land-limited areas

Sustainable, Intensive, and Eco-friendly Aquaculture

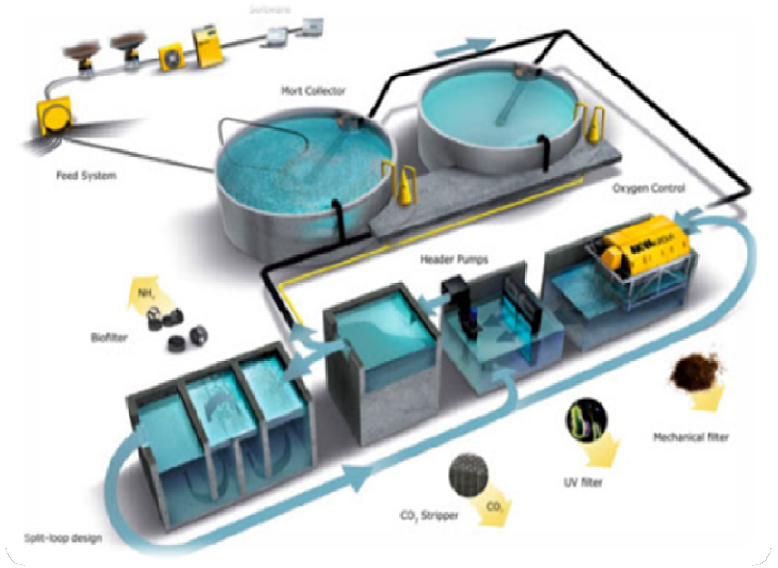


Genetic de
Fish Production
Profit increases



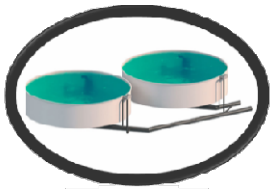
Strategy Behind RAS

- Integrated approach to setup RAS units.
- Increase in fish feed production infrastructure.
- Promotion of indoor culture-based fisheries.
- Cluster approach to be adopted.
- Diversification of cultured Species.
- Tie up of all stages from fish seed to marketing.



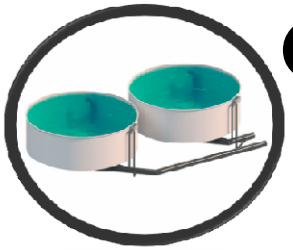
- Source:- NFDB RAS Manual

Water consumption in RAS

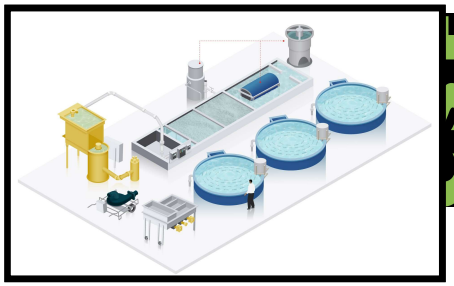


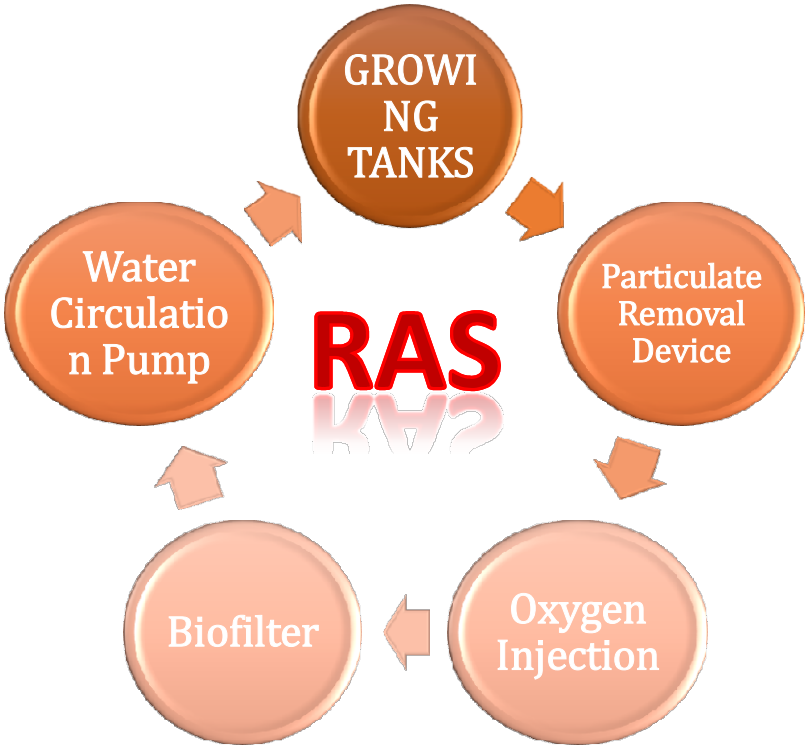
Type of system	Consumption of new water per kg fish produced per year	Consumption of new water per cubic meter per hour	Consumption of new water per day of total system water volume	Degree of recirculation at system vol. recycled one time per hour
Pond Culture	30 m3	1 712 m3/h	1 028 %	**0 %**
Bio Flock	3 m3	171 m3/h	103 %	**75.3%**
RAS intensive	1 m3	57 m3/h	34 %	**95.6 %**
RAS super intensive	**0.3 m3**	**17 m3/h**	**6 %**	**99.6 %**

Source:- FAO 2015



Component of RAS





❖**Design Parameters**

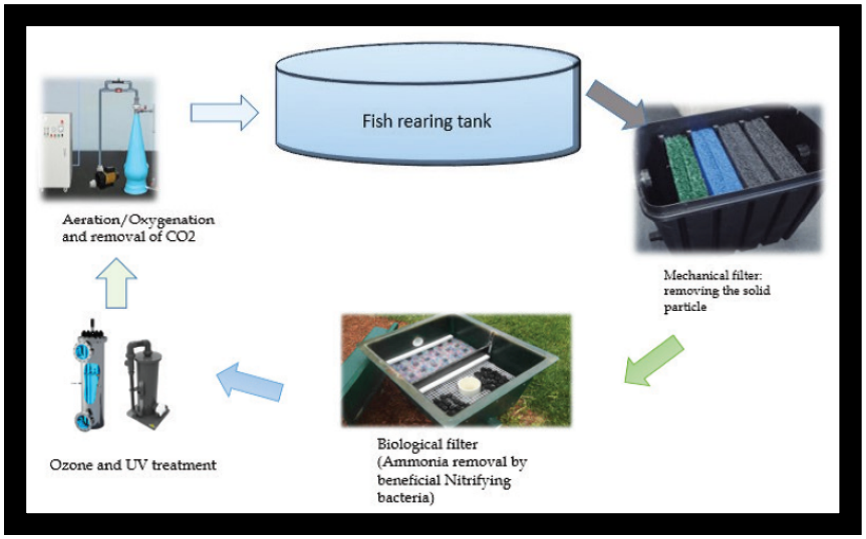
1. Production capacity: 42.70 MT
2. Capacity of each culture tank: 81.93cum
3. Total number of Tanks: 8
4. Total capacity of all tanks: 655.44 cum

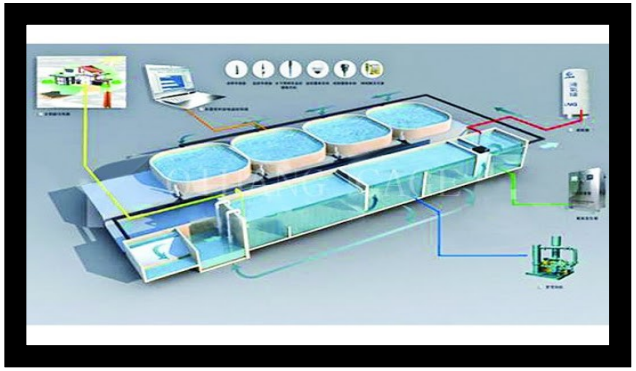
❖**Project Cost:**

1. Total Capital Cost: ` 30,84,648/-
2. Total Operational Cost: ` 19,18,000/-

Total: ` 50, 02,648

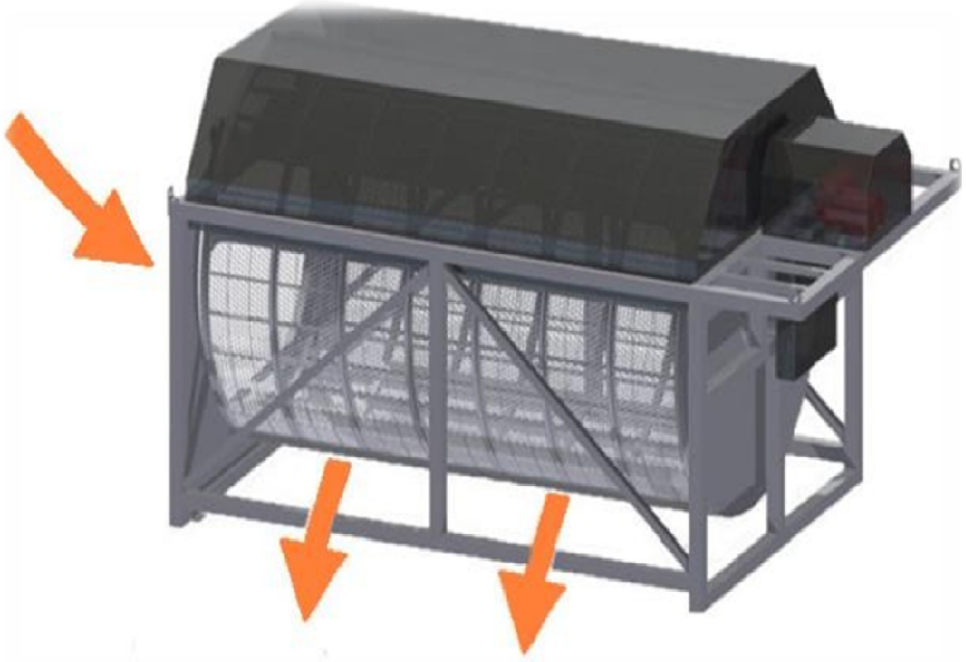
[say Rs.50,00,000/- (Fifty lakh only)]



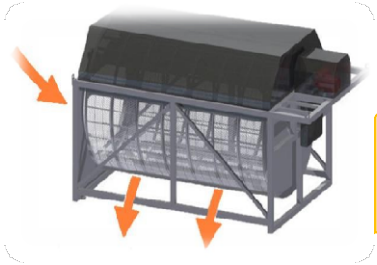


TANKS

- Mechanical filtration of the outlet water from the fish tanks has proven to be the only practical solution for removal of the organic waste products.
- Drumfilter is by far the most used type of microscreen, and the design ensures the gentle removal of particles.



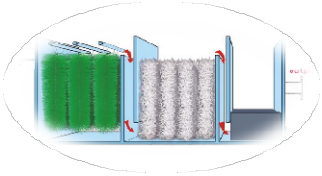
- The Total body is made with SS- 103
- In-built Drive System
- Easy To Clean
- Safety Cover At Top



Function Of Drum Filter

- Water to be filtered enters the drum.
- The water is filtered through the drum's filter elements. The difference in water level inside/outside the drum is the driving force for the filtration.
- Solids are trapped on the filter elements and lifted to the backwash area by the rotation of the drum.
- Water from rinse nozzles is sprayed from the outside of the filter elements. The rejected organic material is washed out of the filter elements into the sludge tray.
- The sludge flows together with water by gravity out of the filter escaping the fish farm for external wastewater treatment.

Bio-Logical Treatment

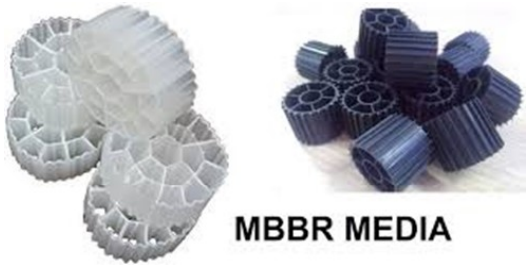


NOT ALL THE ORGANIC MATTER IS REMOVED IN THE MECHANICAL FILTER, THE FINEST PARTICLES WILL PASS THROUGH TOGETHER WITH DISSOLVED COMPOUNDS SUCH AS PHOSPHATE AND NITROGEN.

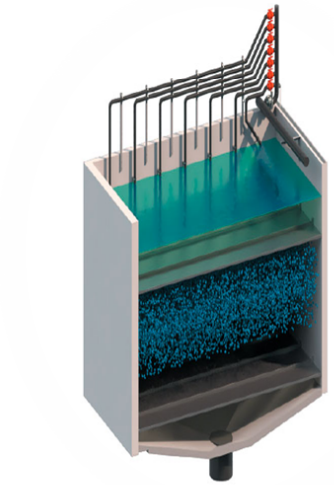
PHOSPHATE IS AN INERT SUBSTANCE, WITH NO TOXIC EFFECT, BUT NITROGEN IN THE FORM OF FREE AMMONIA (NH3) IS TOXIC AND NEEDS TO BE TRANSFORMED IN THE BIOFILTER TO HARMLESS NITRATE.

Source:- William. (1995)

BIO-FILTER



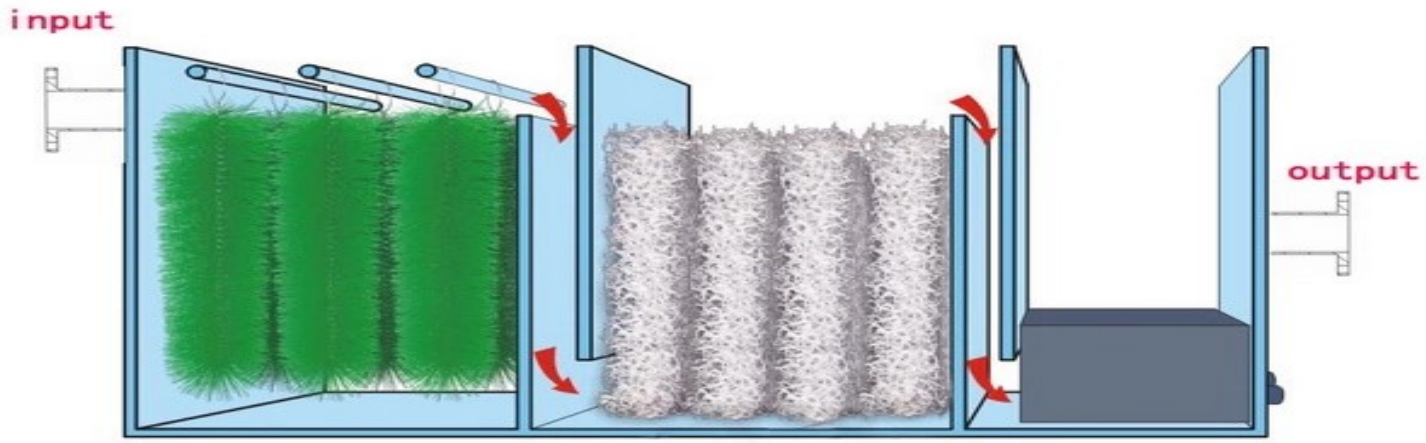
MBBR MEDIA



Bio - Filtration

The efficiency of biofiltration depends primarily on:

- The water temperature in the system.
- The pH level in the system.



pH Effect

- The Production of CO_2 from the fish & from the Bio-Logical activity of the Bio-filter.
- The Acid Produced from Nitrification Process.

❑CO_2 is removed by aeration whereby degassing takes place. This process can be accomplished in several ways as described later in this Concept.

Fish growth							
death	slow growth		good growth		slow growth		death
pH 4	5	6	7	8	9	10	11

Oxygen cone for dissolving pure oxygen at high pressure

There are several ways

of making super-saturated water

with oxygen contents reaching

200-300 %.

Typically high- pressure oxygen cone used.

Closed and open UV treatment systems

In order to control bacteria and viruses the water needs to be treated with roughly 2 000 to 10 000 µWs/cm2 to kill 90% of the organisms

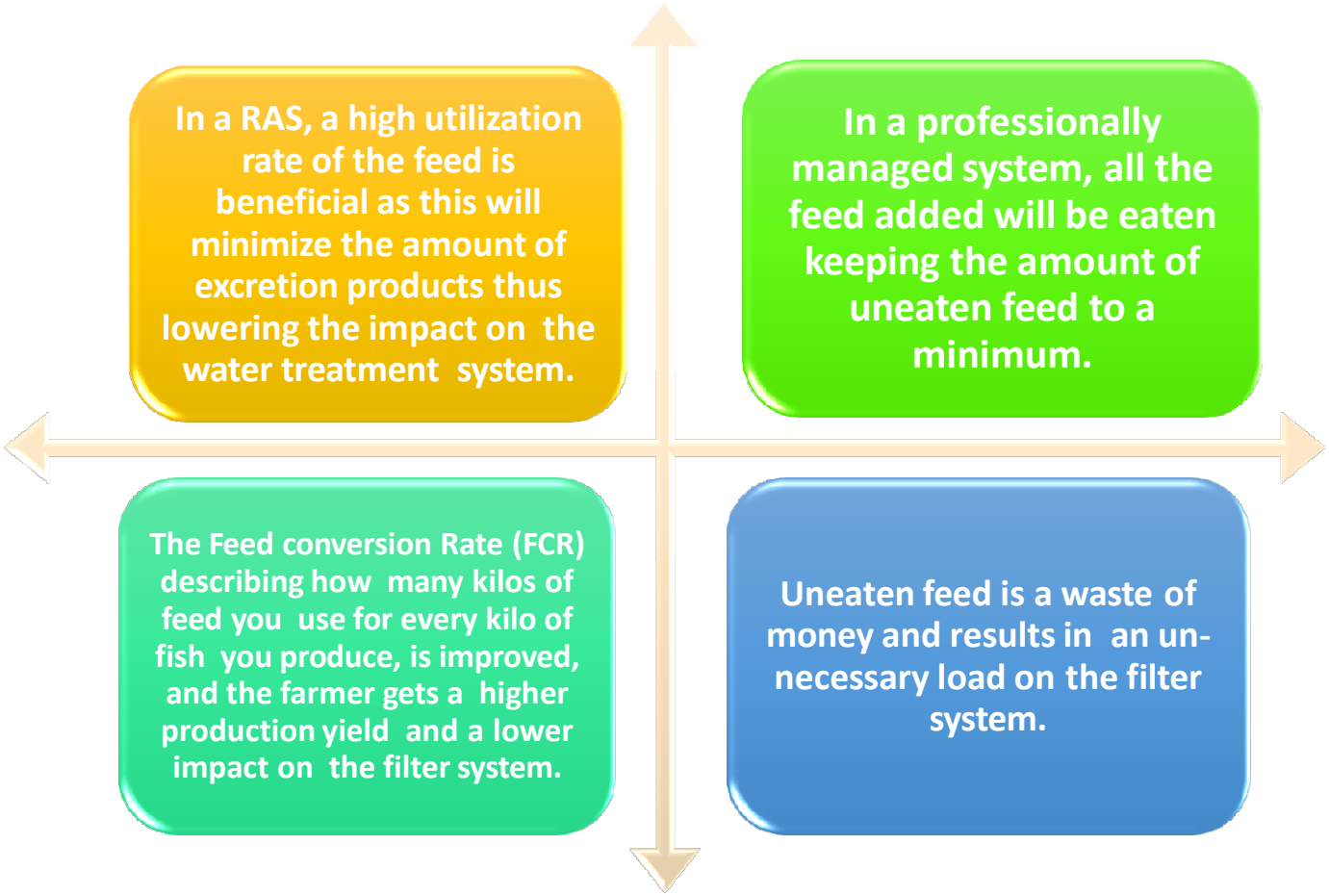
Feeding

The use of dry feed(Float Feed) is safe and also has the advantage of being designed to meet the exact biological needs of the fish.

Dry feed is delivered in different pellet sizes suitable for any fish stage, and the ingredients in dry fish feed can be combined to develop special feeds for fry, brood stock, grow-out, etc.

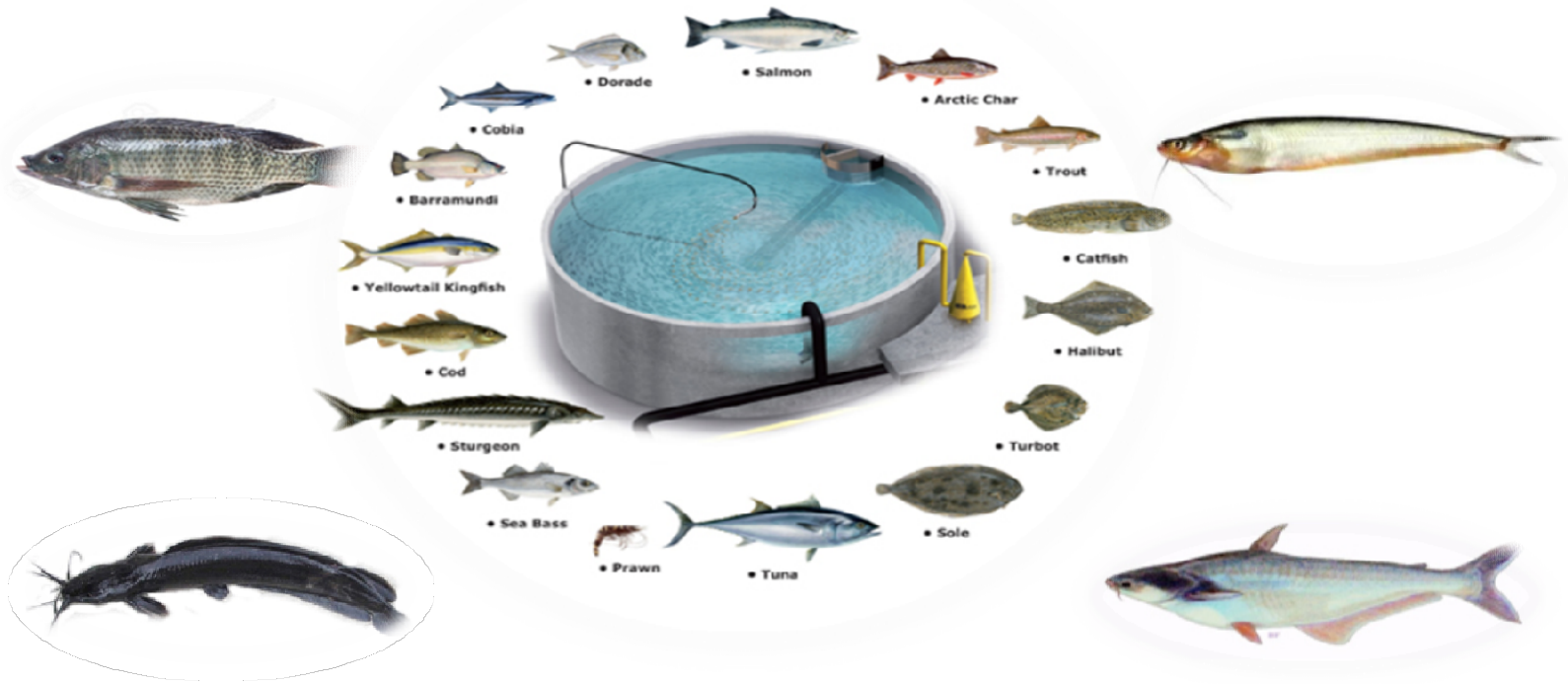
In a recirculation system, a high utilization rate of the feed is beneficial as this will minimize the amount of excretion products thus lowering the impact on the water treatment system.

Feed Conversion Ratio



Useful species of fish for RAS:

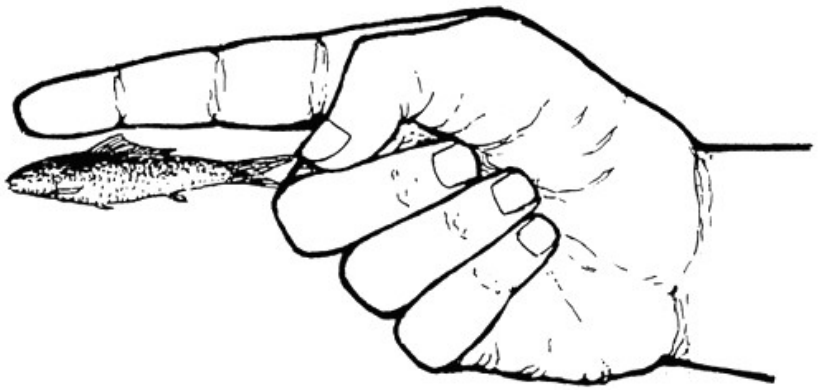
Currently RAS is used by magur (catfish), striped bass, tilapia, carps, channel catfish, rainbow trout, prawn, Vietnam koi. Blue crabs, oysters, muscles and aquatic organisms are being reared.

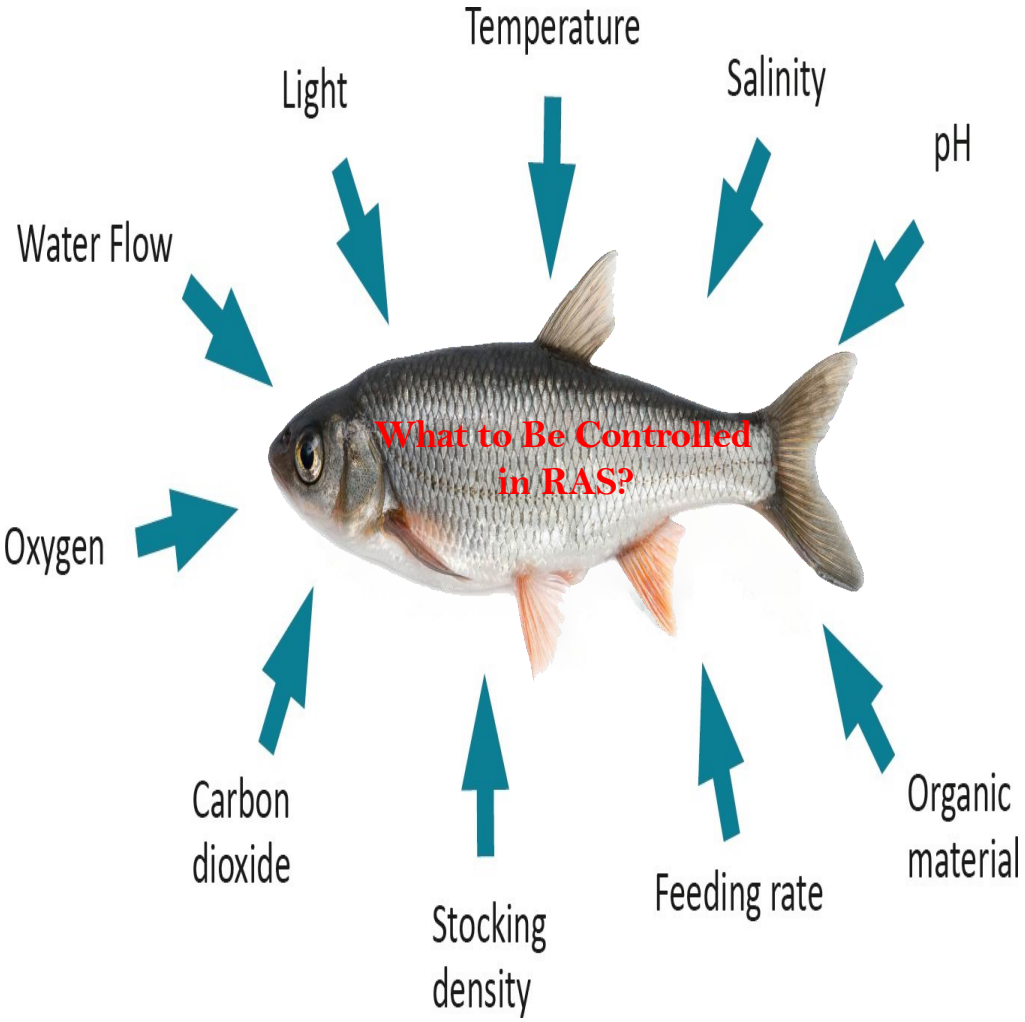


election of fish species for \. criteria

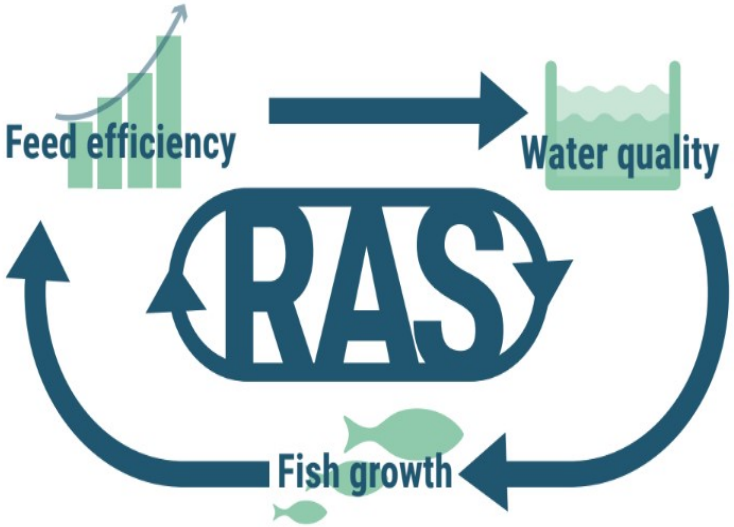
\. requires high capital investment; it is best designed to grow high-value species such as singhi, pabda and anabas for food or stocking in private \. farms.

- heir popularity is a result of the desirable traits that they express. . or example, their culture requirements are well known,
- . arket demand high.
- he economics viable.
- mall (fingerling) fish are available for grow out nearly year-round.
- hey can tolerate crowding and stress, and disease resistant, and grow rapidly to a marketable size.





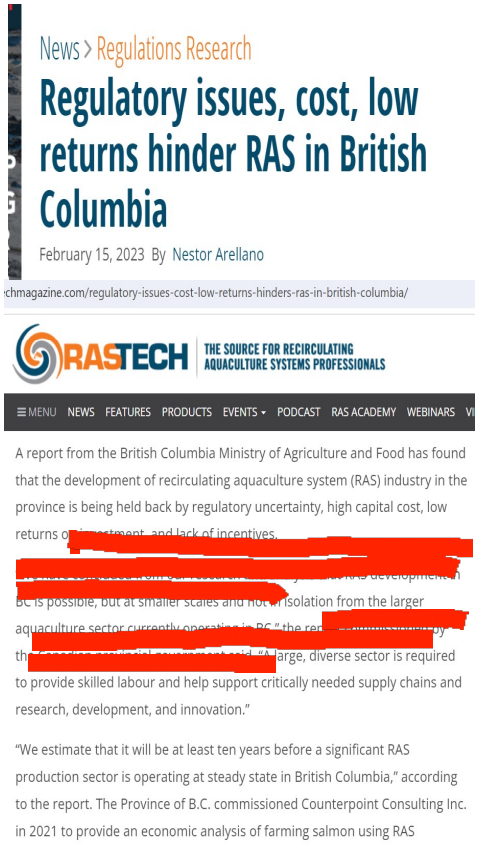
RAS offer several advantages over traditional flow-through systems, including a 90–99% reduction in water consumption, more efficient waste management, and the flexibility to be established at locations closer to markets, thereby reducing transport distance and costs.



Global Failure and Challenges of RAS technology

Failure

1. De Ionno et al. (2007) investigated the commercial performance of RAS farms and concluded that economic viability rises with operational scale. According to this study, **farms with production capacity of less than 100 tons per year are only moderately viable in Australia, where the study was conducted.**
2. There have been many reports of new RAS failing after only a few years of production. This was documented in a **2010 report by CEFAS as being up to 40% between the years 2000 and 2010 in England and Wales.**
3. **Even in Northen India 85% failure cases has been reported in our study during the survey year 2022-2022.**



News > Regulations Research

Regulatory issues, cost, low returns hinder RAS in British Columbia

February 15, 2023 By Nestor Arellano

chmagazine.com/regulatory-issues-cost-low-returns-hinders-ras-in-british-columbia/

RASTECH THE SOURCE FOR RECIRCULATING AQUACULTURE SYSTEMS PROFESSIONALS

MENU NEWS FEATURES PRODUCTS EVENTS PODCAST RAS ACADEMY WEBINARS

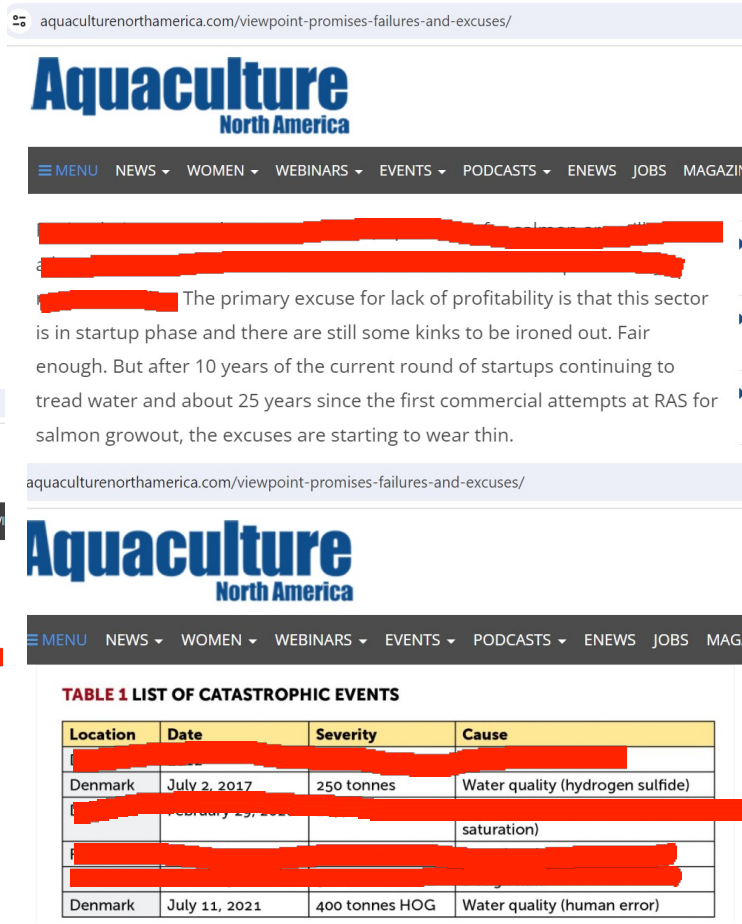
A report from the British Columbia Ministry of Agriculture and Food has found that the development of recirculating aquaculture system (RAS) industry in the province is being held back by regulatory uncertainty, high capital cost, low returns o[redacted] and lack of incentives.

[redacted]

BC is possible, but at smaller scales and not in isolation from the larger aquaculture sector currently operating in BC."the re[redacted]

th[redacted] large, diverse sector is required to provide skilled labour and help support critically needed supply chains and research, development, and innovation."

"We estimate that it will be at least ten years before a significant RAS production sector is operating at steady state in British Columbia," according to the report. The Province of B.C. commissioned Counterpoint Consulting Inc. in 2021 to provide an economic analysis of farming salmon using RAS



aquaculturenorthamerica.com/viewpoint-promises-failures-and-excuses/

Aquaculture North America

MENU NEWS WOMEN WEBINARS EVENTS PODCASTS ENEWS JOBS MAGAZIN

[redacted]

The primary excuse for lack of profitability is that this sector is in startup phase and there are still some kinks to be ironed out. Fair enough. But after 10 years of the current round of startups continuing to tread water and about 25 years since the first commercial attempts at RAS for salmon growout, the excuses are starting to wear thin.

aquaculturenorthamerica.com/viewpoint-promises-failures-and-excuses/

Aquaculture North America

MENU NEWS WOMEN WEBINARS EVENTS PODCASTS ENEWS JOBS MAG

TABLE 1 LIST OF CATASTROPHIC EVENTS

Location	Date	Severity	Cause
[redacted]			
Denmark	July 2, 2017	250 tonnes	Water quality (hydrogen sulfide)
[redacted]			saturation)
[redacted]			
Denmark	July 11, 2021	400 tonnes HOG	Water quality (human error)

The main reasons for these failures have been fundamental design constraints, operational costs and management failings.

Circular Economy

Sustainable aquaculture

Sustainable development is one of the greatest challenges of our time.

Sustainability should be assessed from four different directions: social, environmental, **technological** and economical.

RAS is a technology-based system.

In general, the **sustainability assessment begins in the farm**, but how the technology was produced or how much **waste is generated** by such technology is important as it is also part of the product production.
In **aquaculture and RAS, energy, water and waste** are the three encompassing challenges.

Despite the challenges in developing advanced, efficient, profitable, and environmentally sustainable RAS, their commercial success will rely on multiple integrated strategies rather than a single measure.

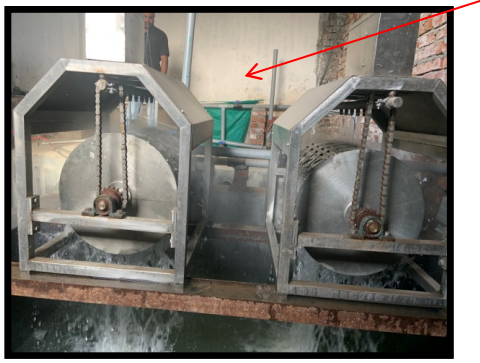
Different types of Challenges and Constraints in RAS

Economical based	Knowledge based	Technical based	Research based
Cost of indoor farm shed	Lack of awareness regarding system specification	Not aware about the RAS training programs	Various RAS models
Cost of filtration equipment's	Lack of awareness regarding system functioning	Not aware about the flow rate calculations	Contradictory filtration systems
Transport cost of equipment's	Lack of awareness regarding system design	Not aware about the bacteria selection and identification	Contradictory statements regarding fish health
Cost of electricity	Lack of awareness regarding system maintenance	Not aware about the role of drum filter mesh screen size	Contradictory research on system design
Cost of Maintenance	Lack of awareness regarding the role of experts	Not aware about the fish feed selection and nutritional importance	Very few training and awareness program
Cost of experts	Not aware about the physio chemical properties of functioning unit	Not aware about the tank design	Lack of problem solving approaches (like; Biological problems)
Cost of Fuel	Lack of knowledge regarding biomass calculation	Off flavour problem	Complex calculations
Longer payback period with higher rate of interest	Lack of knowledge regarding suitable fish species and marketing also	Not aware about the good suppliers	Not aware about the terminology and nomenclature

Case Study

RAS SETUPS IN HARYANA REGION

City Ambala: Swasthik Aqua Farms First RAS farm started pabda fish farming



Total production tanks Water volume is 8 Lakh liters (0.8 million liters) and drum filter installed 30 k liter per hour

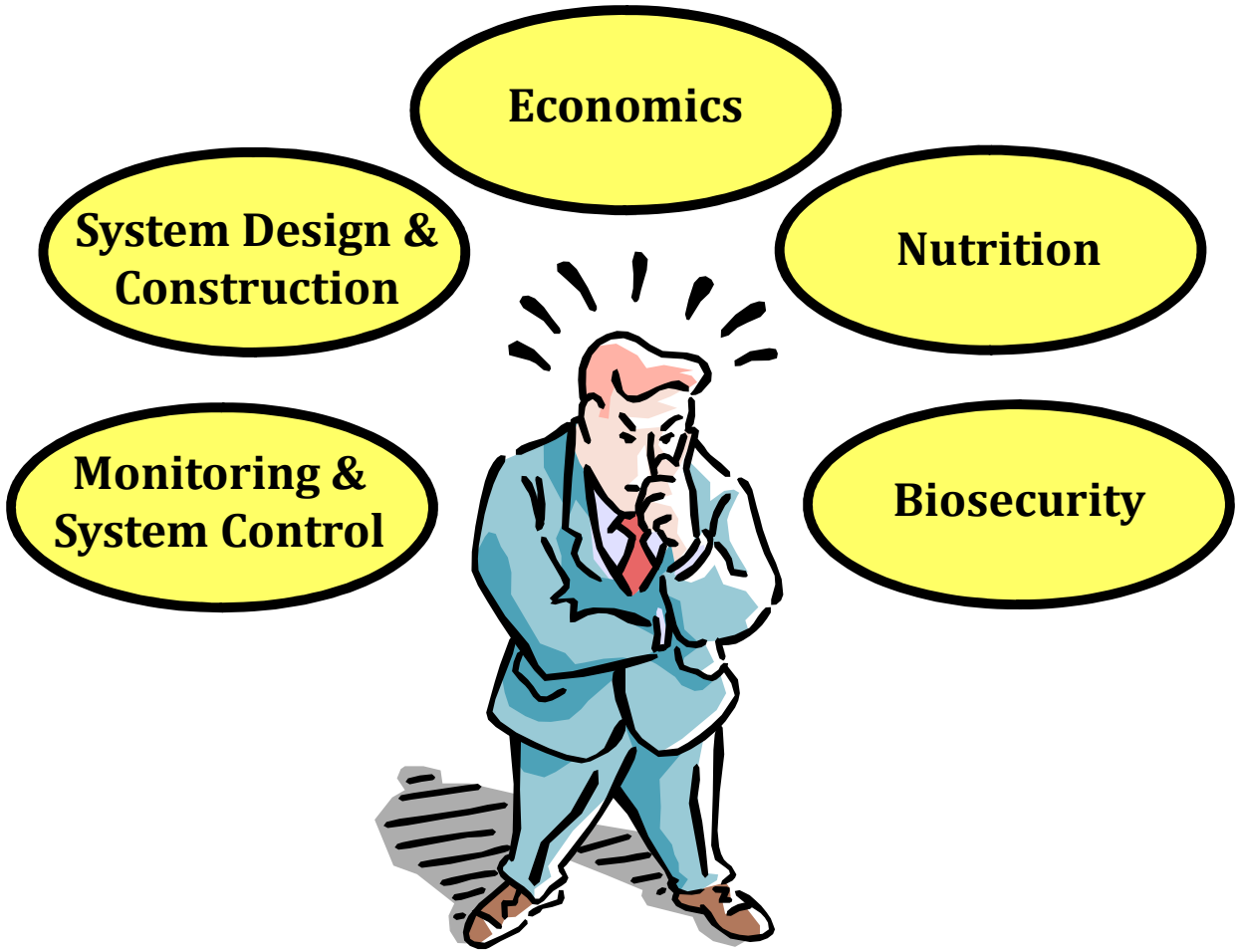
Case Study

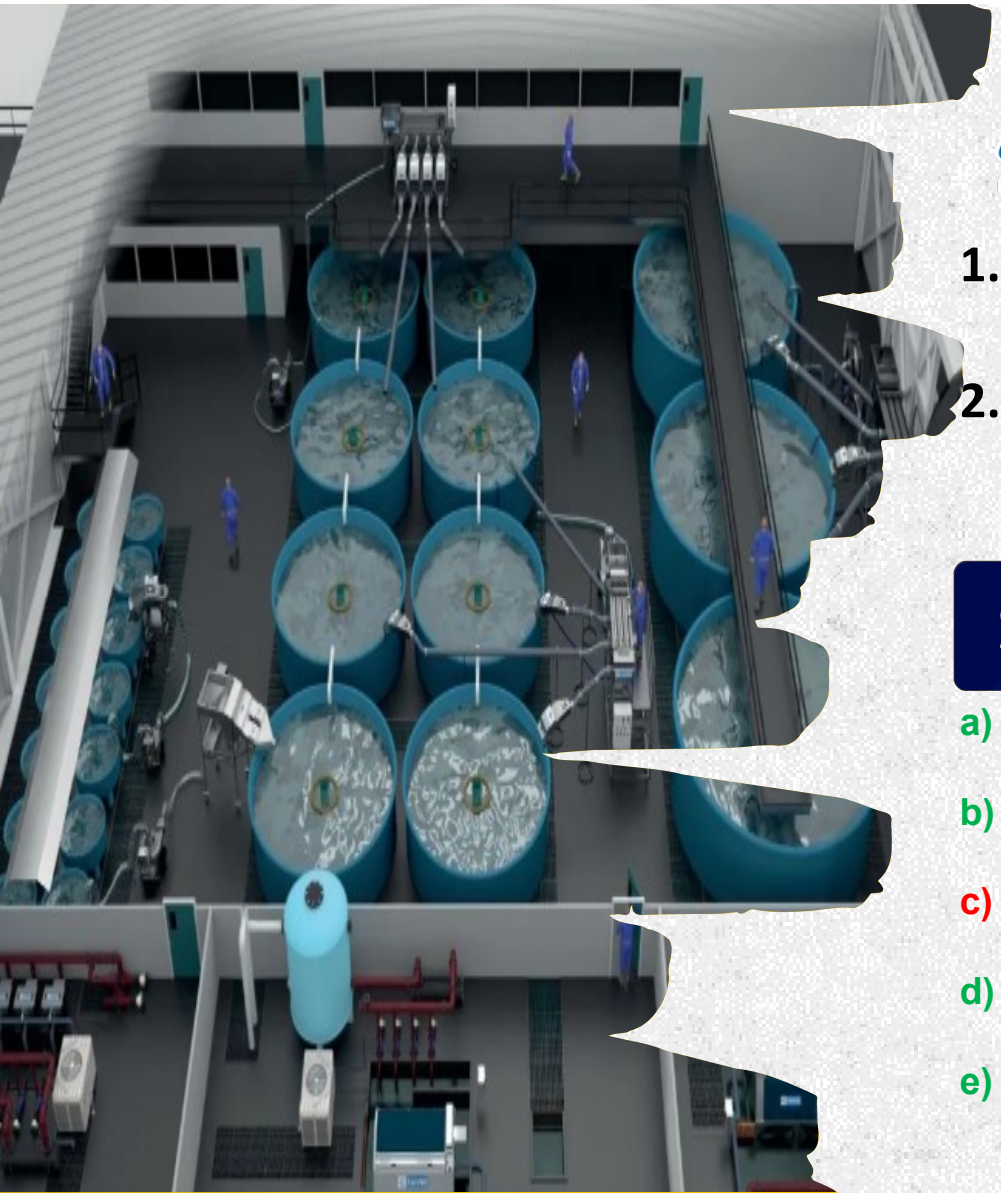
RAS farm near Hisar Haryana

Total production tanks Water volume is 8 Lakh liters (0.8 million liters) and sand filter installed 20 k liter per hour and oxygen cone 10 k liter per hour

Given that it is an integrated system with diverse filtration components, farmers require skilled hands, professional training, and guidance from scientists, experts, and professionals during the initial phases (1-2 years) to learn and install the system effectively.

Management Decisions in RAS is not a single man Game





RULES for RAS

1. First rule is to never invest more than you can not afford to lose.
2. Skills that are inadequate in conventional aquaculture do not automatically translate into competence in RAS aquaculture.

SOLUTION

a) Educate, promote free training programs and hands on workshops for fish farmers with prototype farms.
b) Properly designed RAS can be the most environmentally-friendly systems in the aquaculture industry.
c) Integrates all of the equipment of RAS in to one system for less energy consumption and maintenance.
d) Use of power measurement data, machines and equipment.
e) Use of renewable energy source for power generation will cut the cost of electricity.

Opportunities always comes with challenges

THANK YOU

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