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Seed Rearing of Sea Bass in Low-Salinity RAS: A Sustainable Approach for Inland Aquaculture

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Abstract

Sea bass (*Lates calcarifer*), popularly known as Asian sea bass or barramundi, was recognized as a fast-growing and high-value fish species with strong demand in domestic and export markets. Traditionally cultured in coastal ponds and cages, its production was expanded inland through the use of **Recirculating Aquaculture Systems (RAS).** Studies showed that sea bass seeds performed best at **low salinity levels (0.5–5 ppt),** where they exhibited higher growth, survival, and stress resistance compared to freshwater (0 ppt). RAS provided stable water quality, improved biosecurity and enabled year-round seed production, reducing dependence on coastal resources. Careful feed management, including protein-rich diets and controlled feeding strategies, supported rapid growth while maintaining water quality. Farmers benefited from reduced costs, stronger fingerlings and reliable seed supply. Therefore, low-salinity RAS-based seed rearing offered a **sustainable, profitable and scalable solution** for inland aquaculture.

Key words: Sea bass, RAS, low salinity, Seed rearing.

Introduction

Sea bass (*Lates calcarifer*), commonly known as Asian sea bass or barramundi, is a fast-growing, high-value fish that enjoys strong consumer demand in both domestic and export markets. Traditionally, sea bass farming has been concentrated in coastal ponds and cages where seawater is readily available. However, with increasing pressure on coastal resources and a growing interest in inland aquaculture, farmers and researchers are exploring new ways to expand production. One promising solution is the use of Recirculating Aquaculture Systems (RAS) - a modern farming approach that recycles and treats water to provide a controlled environment for fish growth. Recent studies have shown that sea bass seeds, though naturally tolerant of a wide range of salinities, perform particularly well at low salinity levels between 0.5 and 5 ppt.

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1. Why Low Salinity Works

Sea bass is a euryhaline fish, able to tolerate salinities from freshwater (0 ppt) up to full seawater (35–40 ppt). This adaptability has made it an important aquaculture species. However, while the fish can survive in freshwater, it does not always thrive there. Research shows that rearing sea bass seeds at slightly salty levels (0.5–5 ppt) produces far better results in growth, health and survival compared to freshwater alone.

Growth Performance

Fingerlings reared at around 5 ppt demonstrate the best growth rates. They feed more actively, utilize nutrients efficiently, and gain weight faster. Even at 0.5 ppt, growth and survival remain strong, but performance drops at 0 ppt or higher salinities such as 10 ppt during the seed stage.

Health Benefits

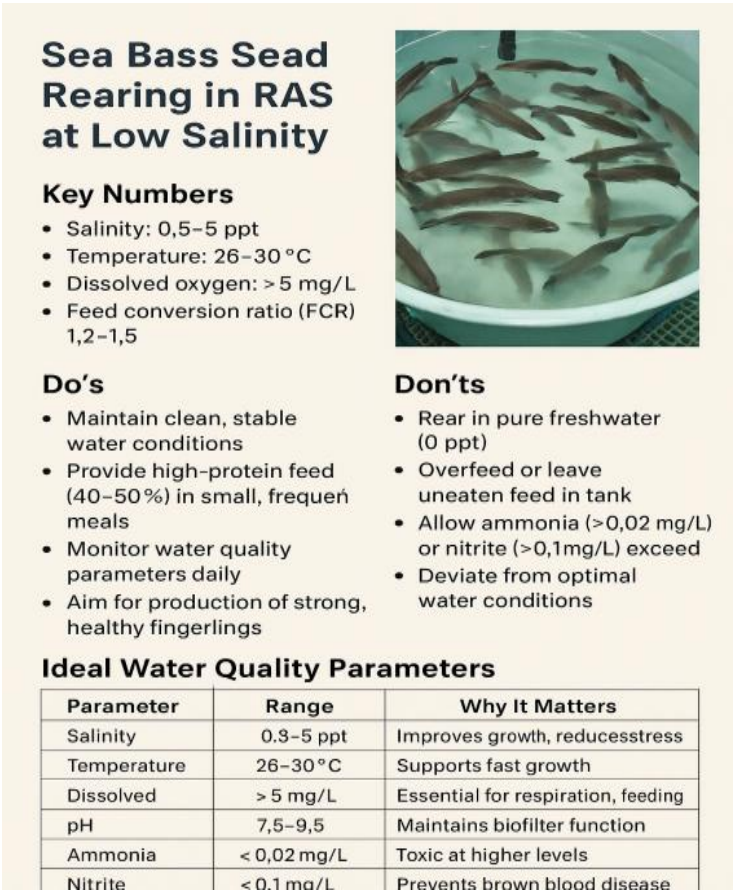
Maintaining internal salt balance, or osmoregulation, is easier at low salinity. In freshwater, fish expend excess energy to retain salts, making them weaker and more disease-prone. At 0.5–5 ppt, less energy is wasted, improving immunity and resilience.

Stress Reduction

Low salinity also reduces physiological stress. Fish in this range show steadier metabolism, better feeding, and higher activity. Farmers note that such fingerlings recover faster from handling and adapt well to grow-out systems.

2. Role of RAS in Seed Rearing

Recirculating Aquaculture Systems (RAS) are a modern approach to fish farming that allow water to be **reused continuously** after it is filtered and treated. Unlike traditional pond or cage culture, where farmers rely heavily on natural conditions, RAS offers complete



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control over the environment in which the fish are raised. This makes it especially suitable for delicate stages like seed rearing, where young fish are highly sensitive to water quality.

Water Quality Control

In RAS, water is constantly circulated through filters that remove waste, excess feed, and harmful compounds like ammonia. Oxygen levels are maintained with aeration or oxygenation units, while pH and temperature are closely monitored. These measures create a **stable, stress-free environment** where sea bass seeds can grow consistently. For low-salinity rearing, maintaining this balance is critical, since even minor changes in water quality can affect fish health.

Biosecurity

One of the greatest strengths of RAS is its **closed nature,** which minimizes the entry of external pathogens. Unlike open ponds or cages exposed to fluctuating environmental conditions, a well-managed RAS acts as a protective shield against disease. This is particularly important when working with low salinity (0.5–5 ppt), because maintaining clean water ensures the fish are less vulnerable to parasites and bacterial infections.

Flexibility for Inland Farming

RAS technology also brings **geographic flexibility**. Farmers who live far away from the sea and who previously could not consider farming sea bass, can now do so. By simply adding a small amount of salt to local freshwater sources, they can create the right salinity levels inside the system. This opens up entirely new regions for sea bass production, reducing dependence on coastal areas and helping spread aquaculture opportunities more evenly.

3. Feed Management in RAS for Sea Bass Rearing

Feeding is the single largest expense in aquaculture, often accounting for more than half of total production costs. In Recirculating Aquaculture Systems (RAS), feed management becomes even more critical because water is reused. Any excess feed or waste can quickly pollute the system, affect fish health and increase maintenance costs. For sea bass, which are active feeders and require protein-rich diets, careful feeding ensures rapid growth, healthy stock and stable water quality.

Nutritional Needs:

Sea bass seeds and juveniles require feeds containing **40–50% protein** with balanced amino acids to support fast growth. Lipids (fats) provide energy, sparing protein for growth, while vitamins and trace minerals (such as Vitamin C and E) strengthen the immune system.

This is particularly important at low salinity (0.5–5 ppt), where fish need extra support for osmoregulation and stress resistance.

Feeding Strategies:

- **Frequent, small meals:** Offering multiple small feedings daily improves feed conversion and reduces waste.
- **Monitoring response:** Farmers should observe fish behaviour—active feeding indicates health, while uneaten pellets suggest stress or overfeeding.
- **Growth stage adjustment:** Fry require micro-pellets, while fingerlings need progressively larger pellets to match mouth size.
- **Water quality care:** Overfeeding increases ammonia and nitrite, straining the biofilter. Proper rations protect both fish and the system.
- **Feed Conversion Ratio (FCR):** A good FCR target is **1.2–1.5**, meaning 1.2–1.5 kg of feed produces 1 kg of fish. Monitoring FCR helps farmers detect problems early.

Innovative Approaches

Automatic feeder

- **Automatic feeders** linked with sensors can release feed in response to fish activity.
- **Floating feeds** are preferred, as they make it easier to observe intake and reduce losses.
- Some hatcheries also test **probiotics and functional feeds** to improve gut health, boost immunity and reduce stress in low-salinity conditions.

4. Water Quality Parameters for Sea Bass Rearing in RAS

Parameter	Ideal Range	Why It Matters	Risk if Out of Range
Temperature	26–30 °C	Supports fast growth and metabolism	Below 24 °C: slow growth; Above 32 °C: stress, reduced oxygen
Dissolved Oxygen	> 5 mg/L	Essential for survival, feeding, and growth	Low DO causes suffocation, poor feeding, and mortality

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pH	7.5–8.5	Keeps fish comfortable and biofilter efficient	pH < 7: stress and biofilter failure; pH > 9: toxic ammonia increases
Ammonia (NH_3)	< 0.02 mg/L	High ammonia is toxic to gills and blood	Causes stress, reduced growth, and death in fingerlings
Nitrite (NO_2^-)	< 0.1 mg/L	Prevents "brown blood disease" (poor oxygen transport)	Fish show lethargy, high mortality
Nitrate (NO_3^-)	< 100 mg/L	Less toxic but harmful in long exposure	Chronic stress, weak immunity
Salinity	0.5–5 ppt	Eases osmoregulation, reduces stress	At 0 ppt: disease risk increases; >10 ppt: slower seed growth
Turbidity / Solids	Low / Clear water	Keeps gills healthy, improves feeding	High solids damage gills, reduce feeding activity

5. Benefits for Farmers

Adopting **RAS at low salinity (0.5–5 ppt)** benefits not only the fish but also the farmers.

- **Inland farming potential:** Farmers far from the coast can now rear sea bass profitably.
- **Cost savings:** Minimal salt use and water recycling reduce expenses compared to seawater farming.
- **High-value seed production:** Stronger, healthier fingerlings fetch better prices and improve grow-out success.
- **Year-round supply:** RAS allows continuous seed production, ensuring steady income and reliable seed availability.

Conclusion:

Sea bass seed rearing in Recirculating Aquaculture Systems (RAS) at low salinity (0.5–5 ppt) represents a major step forward for sustainable aquaculture. By combining the natural adaptability of sea bass with the stability of RAS technology, farmers can produce stronger, healthier fingerlings while reducing costs and expanding production to inland regions. This approach not only ensures year-round seed availability but also opens up new opportunities for farmers far from the coast to participate in the profitable sea bass market. With proper feed

management, strict water quality monitoring, and attention to biosecurity, RAS-based low-salinity culture offers a practical and profitable pathway to meet the rising demand for this high-value fish.

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Slideshare "Recirculating Aquaculture Systems (RAS)" (2014). Explains core benefits of RAS—water conservation, biosecurity, environmental control—which underpin the system's suitability for inland sea bass rearing.