Recirculating Aquaculture Systems (RAS): The Basics

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Introduction

Recirculating aquaculture systems (RAS) offer an alternative to the more traditional culture methods. Aquatic crop production in tanks and raceways where the environment is controlled through water treatment and recirculation. Through treatment and reuse, recirculating systems use a fraction of the water required by other land-based systems to produce similar yields.

Traditional aquaculture production methods require large quantities of water. In many areas of North America, traditional aquaculture in ponds or larger water bodies is not possible because of limited surface water supplies, restrictions on cage culture, or an absence of suitable land for pond construction. RAS have most often used circular tanks, but recently systems have been built that employ one large u-shaped raceway.

On the negative side, RAS technology remains costly in comparison to pond or cage culture, particularly in terms of construction capital. In recent years, a variety of commercial production sized facilities that use recirculating technology have been built, and there have been some notable large-scale business failures in the sector. However, numerous small to medium-scale efforts continue production and technology and methods have been improved. So too has identification of culture and economic sensitivities unique to or accentuated within the RAS approach. There is increasing evidence that given the right location and market, RAS can be viable, but potential owners and investors need to be aware of the basic technical and economic risks involved in this type of aquaculture production technology. This fact sheet, and others related to it, is designed to provide basic information on recirculating aquaculture as one of several possible production methods.

Critical Production Considerations

All aquaculture production systems must provide a suitable environment to promote the growth of the aquatic organism being cultured. Critical RAS environmental parameters include the following:

- Concentrations of critical dissolved oxygen,
- Un-ionized ammonia-nitrogen, nitrite-nitrogen,
- Carbon dioxide in the water of the culture system.
- Nitrate concentration, pH, and alkalinity levels.

In summary, maintaining very high water quality is essential to RAS production.

Feed composition, fish metabolic rate and the quantity of wasted feed affect tank water quality. The by-products of fish metabolism include carbon dioxide, ammonia, nitrogen, and fecal solids. If uneaten feeds and metabolic by-products are left within the culture system, they will generate additional carbon dioxide and ammonia-nitrogen, which in turn reduces the oxygen content of the water, thus creating a direct detrimental impact on fish health.

The carrying capacity of RAS containment vessels must be high to provide for cost-effective fish production because of the higher initial capital costs of tanks or raceways compared to net-pens or earthen ponds. Because of this expense and the limited capacity of the "natural" biological filtration of a tank, the producer must rely upon the flow of water through the tanks to wash out the waste by-products. Additionally, the oxygen concentration within the tank must be maintained through continuous aeration, either with atmospheric oxygen (air) or pure gaseous oxygen.

A key to successful recirculating production systems is the use of cost-effective water treatment system

components. In general water treatment components and processes have continued to improve in their effectiveness and efficiency, contributing to the steady increase in the viability of RAS. All recirculating production systems remove waste solids, oxidize ammonia and nitrite-nitrogen, remove carbon dioxide, and aerate or oxygenate the water before returning it to the fish tank. More intensive systems or systems culturing sensitive species may require additional treatment processes such as fine solids removal, dissolved organics removal, or some form of disinfection.

Other production considerations

There have not been many documented successes in commercial fish production in RAS. Most reports of successful production have been from producers who supply fish live or on ice to local niche markets. These relatively high-priced markets appear to be necessary for financial success due to the high cost of fish production in recirculating systems.

Other points worth considering in considering RAS include the following:

- The variable costs (feed, fingerling, electricity and labor) of producing fish in recirculating systems is similar to other production methods.

- Although the electrical costs of RAS are higher than some other production methods, and feed costs are often slightly less than for other methods (i.e., cage culture) - recirculating production systems can yield better feed conversion ratios than net pens. Labour costs can be similar, if not lower, than those in cage culture.

Why, then, are overall costs generally higher for recirculating systems? The answer usually can be found when comparing the capital cost of these systems.

Comparing the investment costs of recirculating systems with other production methods is critical in making an informed economic viability evaluation. Recirculating systems cost between $1 and $4 per pound of annual production. A $1 increase in investment cost per pound of annual production can add more than 10 cents per pound to the production cost of fish.

However, in specialty high-value niche markets, such as gourmet foods or year-round supply of fresh product, recirculating system production may find viability. The key to niche market success is to identify the market size and meet commitments before market expansion. In most cases, niche markets will limit the size of the production units. As technology and knowledge improves, RAS will likely be able to compete with cage culture and other forms of production

Before investing in recirculating systems technology, the prospective farmer should visit a commercial system and learn as much about the technology as possible. As in all aquaculture enterprises, the decision to begin production and the size of the production unit one chooses should be based on the market and proven efficient technology.

Additional sources of information on RAS:

http://southcenters.osu.edu/aquaculture/aquaculture-extension/boot-camp/intensive-new/recirculating-aquaculture-systems-ras

http://www.blueridgeaquaculture.com/recirculatingaquaculture.cfm

http://www.csmonitor.com/Environment/2010/0224/Recirculating-aquaculture-systems-The-future-of-fish-farming

http://www.recirculatingfarms.org/what-is-a-recirculating-farm/

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