



THE OCEAN FOUNDATION

SUSTAINABLE NEXT-GENERATION AQUACULTURE: RECIRCULATING AQUACULTURE SYSTEMS (RAS)

Half of the world's fish consumption is already produced by aquaculture. Fortunately, there is increasing recognition that sustainable aquaculture can play a key role in the transition toward safer, more environmentally and economically sustainable seafood production, offering a viable, safe and sustainable alternative to fishing wild stocks and one that can bring strong economic benefits. However, widely practiced forms of aquaculture, including coastal and open-ocean net pens,

are vulnerable to storms and other climate change impacts, and to water pollution from sewage, oil, chemical or other human activities. Often, open-water aquaculture operations themselves (especially at large scale) represent a threat to the environment, generating significant pollution, consuming wild resources, and spreading disease and invasive species to marine ecosystems.



LAND-BASED, RAS BARRAMUNDI (ASIAN SEA BASS)
FARM IN MALAYSIA (PHOTO: D. GUGGENHEIM)

NEXT-GENERATION AQUACULTURE

Land-based, next-generation recirculating aquaculture systems (RAS) offer a unique combination of conservation achievements, socioeconomic benefits, and potential for replication. Such technology could lead the way toward a revolutionary transition of fish production just as has been done for many centuries in terrestrial animal husbandry.

Next-generation recirculating aquaculture systems represent a key part of the solution to meet future demand for protein from fish while eventually reducing and eliminating the overfishing of wild fish stocks.¹ This is because they excel across a broad range of both environmental and socioeconomic issues where other forms of aquaculture fall short:

- **Water Pollution:** RAS systems recycle 97-99 percent of their water and create virtually no discharge to natural water bodies, either marine or fresh water.
- **Coastal Habitat Alteration, Destruction:** RAS systems are land-based and can be sited to have no impact on coastal habitats.

¹ Again, as noted above, there is no evidence to date that aquaculture curbs fishing on wild stocks. And, it may not be growing fast enough to keep up with increasing demand/need for fish.

- **Disease:** As a closed system allowing no contact with natural populations, coupled with strict protocols for disease detection, prevention and control, there is little risk of introducing disease to the natural environment from RAS systems.
- **Escapement:** Since RAS systems are closed, quarantined systems, they virtually eliminate the risk of farmed populations mixing with wild populations.
- **Use of Antibiotics, Chemicals:** In accordance with strict operating protocols, no antibiotics or chemicals are used in raising farmed fish in these systems.
- **Use of Fish Meal in Feed:** Fishmeal is a dietary component for predatory/piscivorous finfish. This is an issue that will necessarily be resolved over the coming years and is a challenge that affects all forms of aquaculture. However, because RAS systems exercise complete control over their environment, including temperature control and prevention of food loss, they realize food conversion efficiencies and growth rates more than 10 times higher than comparable open-pen systems.
- **Producing High-Quality Aquaponic Vegetables.** Aquaponic vegetable and herb production is an increasingly common component of RAS technologies, where nitrogen waste from fish is used as input for vegetable production. These vegetables and herbs can command a high market price and produce significant profits.
- **Profitability:** RAS systems have demonstrated consistent profitability at a significant level of return, albeit following a higher initial investment than open pen systems
- **Promoting “in-sourcing”:** In the U.S., we can decrease the amount of imported seafood (both wild caught and aquaculture), while reducing the carbon footprint resulting from international and domestic shipping. In 2008, over 80% of seafood consumed in the US was imported.
- **Jobs, Jobs, Jobs:** RAS facilities offer job opportunities for low-skilled workers and the chance to learn marketable skills in a growing industry
- **Location, Location, Location:** Systems can be placed in neighborhoods and communities where unemployment is high, and wider market access is relatively local, as well as in communities where other forms of food production are uncertain, avoiding transportation costs and impact for production, processing, and delivery. Local production in developed nations can cater to the locavore food movement, and increase certainty on the source and species of fish being consumed.