

# Recirculating Aquaculture Systems: The Facts

What are recirculating aquaculture systems?

Recirculating aquaculture systems (RAS) are ...

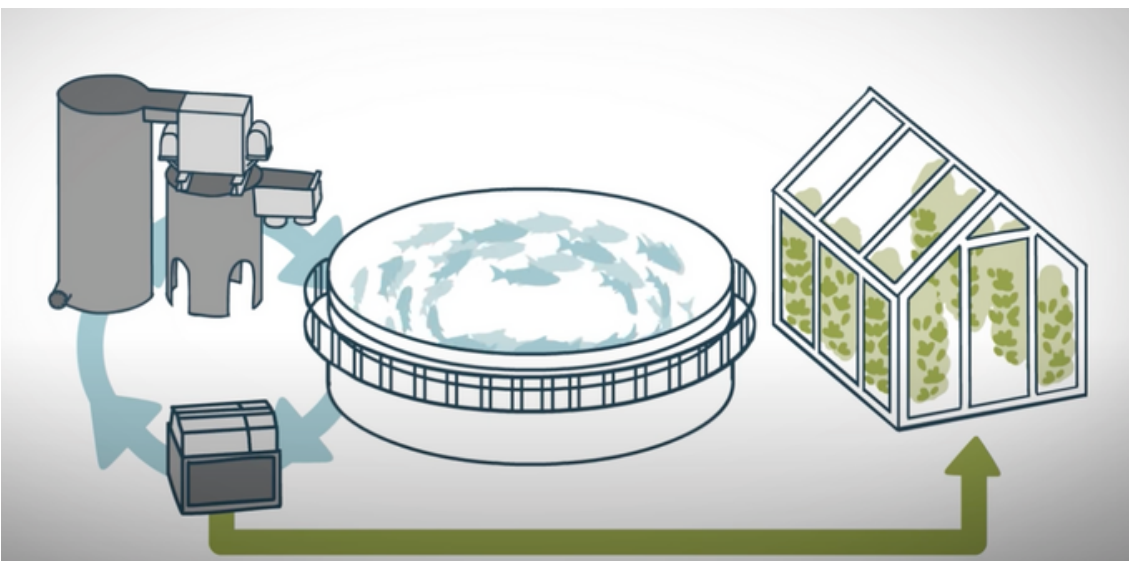
- land-based seafood production facilities;
- full lifecycle;
- highly water efficient;
- biosecure;
- energy intensive;
- capable of raising fish, crustaceans (e.g., crabs), and even bivalves (e.g., oysters!).



Aquaculture Stewardship Council, 2021

RAS is a rapidly developing technology for seafood production, particularly for important species such as salmon and shrimp. Global seafood demand is increasing quickly, so improving our ability to produce safe and sustainable seafood products is critical. These facilities will increasingly become part of global, regional, and even local seafood supply chains

Is this technology safe?



The Conservation Fund, 2016

What chemicals or additives are used in RAS production?

- Low to no antibiotic use
- Low to no chemical additives
- No parasiticides
- No fertilizers

RAS facilities have the advantage of being fully contained, which means that not many chemical additives or antibiotics are necessary to combat diseases or environmental contaminants. (Amhed & Turchini, 2021)

Is RAS good for the environment?


While RAS is not a perfect solution for all the environmental issues that plague the seafood industry, it does have several advantages compared to other aquaculture methods. RAS facilities recycle most of their water, have very efficient feed conversion ratios (the amount of resources needed per/lb of fish produced), and limit impacts to their surrounding environments through an extensive filtration process. On the other hand, RAS facilities use a considerable amount of energy. (Amhed & Turchini, 2021)

90–99%

of water is recycled

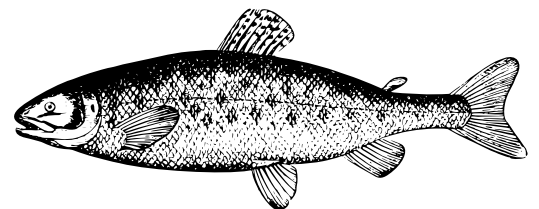
Does seafood produced in RAS facilities taste the same as normal seafood?

Some species, such as salmon, are associated with the naturally occurring compounds, geosmin and 2-methylisoborneol (MIB). These compounds are easily detected by humans and are what give beets and some other vegetables their musty or earthy flavor, and it's also the smell after a rainstorm that we humans are especially good at detecting, a remnant of our ancient ancestors who constantly needed to find fresh water. Don't worry, these compounds are safe for humans. RAS producers reduce or eliminate them through good system management (Abd El-Hack et al., 2022)

	<b>Recirculating aquaculture systems</b>	<b>Coastal Aquaculture: raising marine or freshwater animals in coastal areas in their natural habitat, but contained within nets or cages</b>	<b>Pond Aquaculture: using outdoor ponds to raise marine or freshwater animals</b>
<b>Chemical Additives (disinfectants, antibiotics)</b>	Other limited antibiotic use for some species, RAS technology eliminates the for most inputs necessary in coastal or pond aquaculture.	Coastal aquaculture requires antibiotics and chemical additives to protect livestock from diseases or pests in the environment.	The application of antibiotic treatments and parasiticides is common in many forms of pond aquaculture, especially in places where there are limited regulations.
<b>Animal Welfare</b>	Within RAS facilities, conditions are tightly controlled to maintain ideal living environment for the species in question. Additionally, there are no pests or predators to present harm. Although rare, disease outbreaks in RAS facilities can be devastating, and often result in mortality events.	Animal welfare in coastal aquaculture is dependent on a variety of factors, but certain species such as salmon are plagued by harmful pests. Predators can also prey upon some species raised in coastal environments.	Animal welfare in pond aquaculture is an area in need of more research. However, similarly to other methods, overstocking and diseases can result in poor animal welfare for pond species. Many areas where pond aquaculture is common have few regulations concerning animal welfare.
<b>Sustainability</b>	RAS facilities use significantly less water than pond aquaculture. The energy needs of RAS are higher than those of coastal and pond aquaculture.	While coastal aquaculture doesn't require water inputs or large amounts of energy, these facilities impact marine ecosystems. Noise, light, and effluent pollution directly harm marine animals near coastal aquaculture facilities. Additionally, these facilities can harbor or introduce harmful invasive species.	Pond aquaculture, which are generally flow through systems with minimal or no water recycling, use a great deal of water. This method uses at least twice as much water as RAS, but as much 40x as much water.

Chuah et al., 2016; Refaey et al., 2018; Antonucci & Costa, 2020; Ahmed & Turchini, 2021; Heredia-Azuaje et al., 2021; Elvy et al., 2022

## Where can I buy seafood produced using RAS technology?



The technology is still innovating and growing, but opportunities to purchase products from RAS producers will only increase. Currently, RAS producers are beginning to bring products to market in places like British Columbia (CAN), Florida (USA), and the Netherlands (Martin et al., 2021). Ask your local fishmonger about where they source their products. Researchers continue to develop better systems for a wider variety of seafood.

## Where can I learn more?

For additional information, check out the organizations below or explore the References section.



## References

- Abd El-Hack, M. E., El-Saadony, M. T., Elbestawy, A. R., Ellakany, H. F., Abaza, S. S., Geneedy, A. M., Salem, H. M., Taha, A. E., Swelum, A. A., Omer, F. A., AbuQamar, S. F., & El-Tarabily, K. A. (2022). Undesirable odour substances (geosmin and 2-methylisoborneol) in water environment: Sources, impacts and removal strategies. *Marine Pollution Bulletin*, 178, 113579. <https://doi.org/10.1016/j.marpolbul.2022.113579>
- Ahmed, N., & Turchini, G. (2021). Recirculating aquaculture systems (RAS): Environmental solution and climate change adaptation. *Journal of Cleaner Production*, 297, 1-14. <https://doi.org/10.1016/j.jclepro.2021.126604>
- Antonucci, F., & Costa, C. (2020). Precision aquaculture: A short review on engineering innovations. *Aquaculture International*, 28(1), 41-57. <https://doi.org/10.1007/s10499-019-00443-w>
- Aquaculture Stewardship Council. (2021, May). Explained: What is RAS Aquaculture? Aquaculture Stewardship Council. <https://www.asc-aqua.org/explained-what-is-ras-aquaculture/>
- Chuah, L.-O., Effarizah, M. E., Goni, A. M., & Rusul, G. (2016). Antibiotic Application and Emergence of Multiple Antibiotic Resistance (MAR) in Global Catfish Aquaculture. *Current Environmental Health Reports*, 3(2), 118-127. <https://doi.org/10.1007/s40572-016-0091-2>
- Elvy, J. E., Symonds, J. E., Hilton, Z., Walker, S. P., Tremblay, L. A., Casanovas, P., & Herbert, N. A. (2022). The relationship of feed intake, growth, nutrient retention, and oxygen consumption to feed conversion ratio of farmed saltwater Chinook salmon (*Oncorhynchus tshawytscha*). *Aquaculture*, 554, 738184. <https://doi.org/10.1016/j.aquaculture.2022.738184>
- Heredia-Azuaje, H., Niklitschek, E. J., & Sepúlveda, M. (2022). Pinnipeds and salmon farming: Threats, conflicts and challenges to co-existence after 50 years of industrial growth and expansion. *Reviews in Aquaculture*, 14(2), 528-546. <https://doi.org/10.1111/raq.12611>
- Martin, S. J., Mather, C., Knott, C., & Bavington, D. (2021). 'Landing' salmon aquaculture: Ecologies, infrastructures and the promise of sustainability. *Geoforum*, 123, 47-55. <https://doi.org/10.1016/j.geoforum.2021.04.025>
- Refaey, M. M., Li, D., Tian, X., Zhang, Z., Zhang, X., Li, L., & Tang, R. (2018). High stocking density alters growth performance, blood biochemistry, intestinal histology, and muscle quality of channel catfish *Ictalurus punctatus*. *Aquaculture*, 492, 73-81. <https://doi.org/10.1016/j.aquaculture.2018.04.003>
- The Conservation Fund (Director). (2016, October 11). What is land-based fish farming? <https://www.youtube.com/watch?v=pxp7SKs8GE4>

