



Danish land-based salmon farm Langsand Laks. Photo: Langsand Laks

Letter: 'Naive' land-based salmon investors will lose their shirts

Danish aquaculture expert says land-based salmon ventures 'in heavy need of a dose of common sense.'

IntraFish Media

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*In reaction to recent **IntraFish** and **Fish Farming International (FFI)** reports on the profitability of land-based salmon farming, Karl Iver Dahl Madsen (pictured below), independent consultant and former president of Dansk Akvakultur and AquaCircle, wrote in a letter "the discussion in FFI about land-based ongrowing of salmonoids is interesting but in heavy need of a dose of common sense."*

He shared his views in the following letter:

The bulk of ongrowing of large salmonoids will in the foreseeable future take place in cages in the sea. This production method can thoroughly trash any land-based farming from an economic point of view, and is more sustainable than land-based farming because of the very low energy demand.

RAS [recirculating aquaculture systems] and other land-based systems has a great future for other purposes, but not for ongrowing of salmon. It is harmful to the industry that companies and half-baked researchers with vested interests in selling equipment and research project are hyping RAS systems for salmon. The industry should become organized and agree on realistic ways for jointly furthering our aims.

The use of RAS systems for land-based fish farming is not at all new. RAS is a well-known technology, which were developed to full-scale production by the Danes in the late seventies as an energy saving technology for ongrowing of eels. It is no coincidence, that Danish companies organized in AquaCircle are major players in the RAS field. It all has its roots in the know-how and technology acquired during the eel farming adventure of the eighties.



These companies have prospered selling equipment for culturing expensive species like eels, and first and foremost by selling RAS salmon smolt production facilities. Basically, the success of sea cage salmon farming has made their market and their business [on this success].

Since the 80s [there have] been 50-100 ventures in full-scale land-based farming of large salmonoids. All of these have been abject failures going bankrupt after a few years. I safely forecast

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that all the ventures newly started by naive investors not doing their homework, also will lose their investors' shirts.

The reason is very simple. Land-based RAS systems for salmon farming are much too expensive. A factor of at least five and probably more like 10 times higher investment cost than for sea cages. On top of that, an additional running cost of at least two kWh per kg produced fish. It all adds up to a realistic production cost of up to 50 percent more than for a sea cage farm. And that is even with the benign interest rates of today, and worst of all by assuming that everything goes as planned, which it never does in full-scale complicated RAS for on-growing.

The siren songs of the RAS hypens are several.

Better control

It is in theory possible to keep constant optimal conditions for growth factors like temperature and salinity, which will surely make the fish grow faster than under varying conditions in the sea. The higher theoretical growth rates do not by itself mean a lot for the economy, as they are already built into the investment costs. There is some cash flow advantage though.

What really would matter is if RAS systems could give a much better feed conversion efficiency than in open sea cages. It is true that many sea cages today are located sub-optimally with temperatures far from optimal, fluctuating salinities, too low water exchange and subjected to pressures from sea lice and harmful algae, and therefore has suboptimal FCRs [feed conversion ratios]. However, this is a location challenge. In Denmark, we are moving to off-coast and offshore farming, which are still an order-of-magnitude less expensive than RAS systems and where the conditions are near optimal. To be fair, this is what RAS systems have to be compared against, and then the differences in FCR would be marginal.

The greater control of RAS is purely theoretical. In the real world, it does not work like that. RAS systems are in reality the interdependent culture of two groups of organisms: fish and bacteria. If the fish does not thrive, the bacteria will be hurt and vice versa. This exponentially multiplies what can go wrong and explains why RAS systems very often break down, when they are reaching their design capacity. Because RAS systems are so expensive, they are built to produce very close to their design capacity, which is bad engineering. The reason for the success of the RAS smolt farms is that economy is not such a big issue and the capacity reserves are designed to be much higher.

No diseases

This is simply rubbish. Of course, it is correct that a closed RAS system makes it easier to prevent a disease entering the facility. However, it also makes it much more difficult to get rid of the disease. Disease problems are a given fact for most aquaculture productions. It may be possible to control those in RAS systems, but not without significant economic consequences.

The nearest thing to disease-free system in aquaculture is off-coast sea farming at the right location, [for example] in the Baltic near Bornholm, where a pilot project this summer has had no problems with disease.

Fish quality

The postulate is that by controlling the water currents in the RAS tanks, it is possible to exercise the fish for good muscular structure and less stomach fat. That is likely enough, but is not different from what you would get in an off-coast sea cage in a under good current conditions.

What the RAS enthusiasts do not emphasize is the major quality issues in the RAS systems. First, there are issues with early maturation, but even worse off-flavor is a well-known issue in RAS systems. It is occurring randomly, and it is very difficult, probably impossible, to fully control the issue without huge investments. For this reason, RAS growers of trout and eel keep the fish in clean water for a period before sales to flush them free of bad taste. This is feasible with small fish like trout and eels, where the flushing period takes days, but not for big salmon, where the flushing period can be weeks.

Environment

It is true that the discharge of organic material, nutrients and auxiliary substances can be controlled in RAS systems. However it also true that the discharges from an off-coast sea farm located in a high current area will only have a marginal, maybe even a beneficial, influence on the environment. It is however a fact that RAS systems use a lot of energy, at least 2 kWh per kg fish produced, which is obviously bad for the environment.

On top of that comes the energy to the cement tanks, which is substantial. Intermittent renewable energy in form of wind and solar power cannot be used for fish farming, as the fish needs pumping and aeration around the clock and renewable energy is for the foreseeable future much too expensive anyway. Therefore, the RAS farms will have to run on fossil fuel power. On the contrary, marine sea cage farming uses renewable energy in the form of current and waves to supply oxygen and flush the cages.

Fish welfare

On the surface, it could be good for the fish to live in a theoretical optimal constant environment. As mentioned, this is theory, and in practice, the water quality in the RAS systems will vary a lot. However, even if constant conditions are obtained, it comes at a cost to fish welfare: Density, which has to be in the 100 kg/cubic meter area to make it economically feasible. Even if the recirculated water incoming to the fish tanks is very pure, we still have a high accumulation of CO₂, ammonia and various obnoxious substances in the tanks.

The bottom line: In a high intensity, RAS system, fish are swimming in circles all day round in densities like herring in a barrel, looking at a cement wall, being bored to death and nipping fins and irritating their sensitive gills and eyes by bathing in their own excreted.

The consumers have not yet come around to be very interested in fish welfare. Nevertheless, this will happen, and then they will turn to fish cage farming, where the fish swim in much lower densities (up to 25 kg/m³) in huge net-cages with pristine water and have a first row view to the sea. Just like cattle on a nice field. If the consumers ask for even lower densities like in organic farming (<10 kg/cubic meter), it will not be a problem for the sea cage farmers, as it is very cheap to get more space for the fish. However, it would be devastating for the economy of the RAS farmers.

RAS technology is a powerful technology, which has many good uses and an important future in aquaculture. It can be used for very expensive species, which can carry the costs: eels, pike perch etc. It can furthermore be used for crucial development stages like salmon smolt. It could substitute the supply of fresh salmon by air to locations far-away from the salmon cultures like Beijing or Chicago. In addition, it could be part of integrated land and sea cage culture system in places like Denmark, where for the time being is it not possible to grow fish in the sea all year round.

A mature industry, which is free of misguided interference from green NGOs and environmental bureaucrats, would on its own evolve the optimal combinations of land- and sea-based farming as well economically as environmentally.

We have to be aware, though, that we are up against powerful and very wealthy players, particularly US NGOs who hate salmon culture and would like it stopped, so salmon again can become a luxury item for rich sports fishermen.

As these players has not been successful in directly stopping salmon culture, which has been a tremendous success among consumers, they try to the next best thing, which is calling for salmon to be produced in a manner which is obviously not economically feasible. In this venture, they are involving "useful idiots" in green NGOs all over the world.

Unfortunately, we are now in Denmark and Norway countering powers who try to stop sea cage farming by referring to the option of land-based culture. We need as industry to talk to the RAS enthusiasts among us and ask them to market their technology in a responsible and realistic manner. Or else parts of our industry will be supplying the reasons for the bureaucrats to kill the other most profitable and environmentally friendly parts of the European industry, which is and will in the future be well-located sea cage farming of large salmonids.

Karl Iver Dahl Madsen

Former president of Dansk Akvakultur and AquaCircle

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*Read more on the scales and economics working for the world's land-based salmonid producers in our **IntraFish industry report: Land-based salmon farming: Future or fantasy? Buy it now.***
