

LAND-BASED SALMON FARMING CONCERNS AND RESPONSES

Land-based salmon aquaculture using recirculating aquaculture system technology (**RAS**) is a rapidly developing industry that is maturing just as global consumer demand and preferences are changing.

The rate of change means it's important to distinguish industry traits of the past from those of the present and the future in order to allow for meaningful assessment.

The forces of change mean the status quo isn't an option. Investors are willing to fund land-based salmon aquaculture using RAS because it's well suited to present and future market needs:

- global demand is increasing rapidly while ocean-based global aquaculture is reaching limits and cannot keep up;
- land-based salmon farming solves all the environmental impact problems experienced by current open net-pen farming;
- land-based salmon farming has the potential to achieve more operational certainty with less business risk than ocean-based salmon farming, which is subjected to environmental conditions; and
- land-based salmon farms can be located closer to their final markets, which reduces transportation costs and carbon footprints.

As new land-based operations come on stream, they will force change in traditional producing regions like British Columbia. Technology changes in aquaculture are inevitable. Disruptive change is the norm in many industries, and salmon farming is no exception. Developments in salmon aquaculture are analogous to changes in the energy sector with the onset of fracking and adoption of alternative energy sources such as solar power. In salmon aquaculture, change is driven by the costs of ocean-based salmon farming rising steadily due to its cumulative impacts on the ocean, changing ocean conditions, and the industry reaching limits of available sites.

Change is inevitable. We have a choice - to embrace, manage and benefit from change, or to have change imposed upon us, with the potential result of being shut out of the new opportunity. There is a global consensus among aquaculture analysts that land-based salmon farming is the most promising technology to grow the industry. More than \$3.5 billion of investment in new land-based Atlantic salmon projects totaling 200,000 metric tons of annual production has been announced in the eastern United States. Despite such clear evidence of the direction of salmon aquaculture, existing ocean-based interests still suggest land-based salmon farming is not viable. This is part of the history of the land-based industry and not the present reality. *The concerns that are commonly raised, and the corresponding reality, are listed below.*

SCALE

Concern: Land-based aquaculture is only good for small niche projects with specialized species.

Reality: This is not true. Historically, land-based RAS technology was limited to growing high-value species because the costs of production were high and volumes produced were small. The high margins of such operations funded on-site R&D and allowed the technology to be refined to the point it became logical to consider its applicability to higher volume, lower margin species such as Atlantic salmon.

Concern: All current land-based salmon operations are small, less than 1000 metric tons, and have a long path to go to be economically attractive on a large scale.

Reality: The development of new technologies commonly follows this path: Basic science, then applied science and R&D activities, then small-scale, proof-of-concept pilots and finally, full-scale commercial

implementation. Once the pilot-scale facilities have proven the concept, the facilities are scaled up and the technology is broadly adopted. A handful of land-based salmon farming companies have proven the technology in small facilities. Now, larger facilities, one of which is planned to produce as much as 90,000 metric tons per year, are under construction in the USA, Denmark, Norway, and elsewhere. Because the technological and biological parameters of this technology have now been defined, along with the product being well received by the market, all the elements of a scaled up business plan have been proven. Early adopters are now racing to secure market share and reap the rewards of being first to market at scale. It takes several years to locate a site, obtain permits, build the facility, stock it and grow the fish to market size. Proof of profitability at a large scale will follow that process in a few more years. By then, early adopters will have a significant advantage over their competitors.

FUNDING

Concern: Existing land-based salmon operations are heavily subsidized by governments or grants.

Reality: Government or grant funding is common in the early stages of innovative new industries, and land-based salmon aquaculture is an example of this. Such funding is necessary when an industry has promise, but the business risk is still too great for private sector investors. Public funding then decreases as risk decreases and investors seek participation. Land-based salmon aquaculture is in this transition, having benefitted initially from funding through Sustainable Development Technology Canada. At the same time, the federal government supports all aquaculture with programs such as the Clean Technology Adoption Program and Aquaculture Collaborative Research and Development Program. The land-based salmon industry needs to be considered for such ongoing programs which continue to benefit the whole aquaculture industry.

In its report dated February 6, 2017, the Federal Advisory Council on Economic Growth stressed that “Innovation is crucial to addressing the core challenge of maintaining living standards and growing our economic output.” It noted a fundamental problem with Canadian innovation: “even though our entrepreneurs are good at launching companies, very few companies achieve significant scale.” This is especially true in capital-intensive sectors such as clean technology, e.g. land-based salmon farming. The Council recommends that government “Accelerate adoption of innovative new technologies by modernizing regulations and expediting permitting timelines for clean tech companies” and that government provide more, not less, financial support to help small clean tech companies scale up.

PROFITABILITY

Concern: None of the current land-based salmon operations is currently profitable.

Reality: Even at only 300 metric tons per year the Kuterra land-based Atlantic salmon pilot has positive operating cash flow. There is little financial information available about other operations, but conclusions may be drawn from investors' participation in those operations. For example, Atlantic Sapphire, which has evolved from one of the first small-scale land-based operations, is expanding its first farm in Denmark and is now listed on the Oslo Stock Exchange. Atlantic Sapphire has also secured \$70 million in equity and \$60 million in bank debt for its 90,000-metric-ton per year facility under construction in Florida. This suggests they have a profitable business model.

ENVIRONMENT

Concern: Land-based salmon operations have environmental challenges in the use of land, water, energy and fish welfare.

Reality: Operations such as Kuterra have demonstrated that these environmental concerns have no basis. They are myths that are no longer repeated by informed observers:

LAND-BASED SALMON FARMING UPDATE

LAND - If the Kuterra model were scaled up to produce all BC's current level of Atlantic salmon production, it could be done in an area less than half the size of Vancouver's Stanley Park.

WATER - Land-based salmon operations clean, recycle and reuse most of their water - more than 99 percent on each water cycle. The small amount of water discharged is clean and can be used to grow plants in aquaponics operations. The solid waste is collected, composted and can be used as fertilizer.

*ENERGY/GHG*s - The Kuterra model has shown that energy use is much lower than expected. The main energy use in land-based operations is for pumping water. The Kuterra facility was designed to use gravity-assisted flow as much as possible, which has resulted in the low energy use. The facility also incorporates other energy-saving measures, such as geothermal heating and cooling. Land-based facilities have the additional advantage that the facilities themselves are close to transportation routes and energy grids, and so they save on transportation fuel and generator (diesel) power. Instead, in BC at least, the electricity used is generated by hydroelectric plants, so the power used produces very few GHGs. Some of the carbon dioxide produced by the salmon can be captured and used for aquaponics operations.

FISH WELFARE - Salmon grown in land-based operations do not experience the stresses of fluctuating environmental conditions (e.g. low oxygen, toxic algae blooms, pathogen transfer, sea lice, super chilling, etc.) and predator threats. The evidence of low stress growth is seen in the physical appearance and behaviour of the land-raised salmon, their growth rate and in the quality of the harvested salmon. Based on this evidence, the stocking density limits set by land-based operations are not a detriment to the health and welfare of the fish. The schooling behaviour of salmon in the wild and in ocean pens supports this conclusion. Kuterra (and recirculating aquaculture systems in general) has been praised by an animal welfare consultant for the level of fish welfare provided by its growout facility. This consultant works for an animal welfare organization preparing fish welfare standards for aquaculture.

LOCATION

Concern: If large-scale land-based salmon aquaculture is viable, it will only require large amounts of groundwater, and so can be built near major markets instead of in BC.

Reality: Land-based salmon operations have several critical requirements, which British Columbia ideally meets. These are BC's natural advantages that can fuel land-based industry development:

WATER - Water composition is a critical operational factor. A set level of salinity is desirable, and access to seawater helps maintain that level. So proximity to the ocean and access to clean groundwater are both desirable site characteristics.

LAND AND TRANSPORTATION - The cost of land is a factor in the business case for land-based operations. Lower land costs will offset transportation costs to some degree. High land costs and local opposition to industry generally (permitting challenges) are barriers to development near large urban centres. The regions of BC that are well suited for land-based aquaculture are close to their natural major markets - 50 million people along the US West Coast corridor alone, with western Canada and Asia also being substantial markets.

INFRASTRUCTURE - British Columbia has an established aquaculture industry ecosystem with highly skilled workers in BC's current RAS facilities, which include hatcheries, in feed mills, fish health, processing, equipment supply and in distribution. This infrastructure substantially favours BC over regions with no previous history in aquaculture or commercial fishing.

PROGNOSIS - For all the reasons listed above, the growth of land-based aquaculture will likely increase the number of regions producing Atlantic salmon, but not to the extent of moving production to most major population centres. The large-scale land-based projects developing on the East Coast of the US leave BC ideally positioned to supply its extensive natural markets in Western Canada, the US West Coast and the Pacific Rim. Along the US West Coast alone, market demand for Atlantic salmon exceeds 100,000 metric tons per year.

COMMUNITY BENEFIT

Concern: The existing open net-pen industry directly employs approximately 6,600 British Columbians, with around 30 percent of employees in large companies being First Nations.

Reality: The existing open net-pen industry *directly employs approximately 3,000 British Columbians*. * Land-based operations require roughly the same number of people as comparably sized open net-pen operations, and support the same number of indirect and induced jobs.

Planning, and a controlled transition from open net-pens to land-based operations will protect aquaculture jobs, which are currently being threatened by changes in the industry. As the existing industry tries to come to terms with technological and market threats, governments can work with communities and the developing land-based industry to prepare for the transition to the new reality:

- Short term: Land-based salmon farming is contributing to community benefits and jobs, some of which are already held by First Nation members.
- Medium term: Land-based farming can take advantage of currently unrealized market opportunities. For example, land-raised Atlantic salmon is being sold in outlets that previously refused to sell farmed salmon. Government support, training and apprenticeship programs can be implemented to prepare more British Columbians for the well-paid, high-quality jobs in land-based facilities, as well as to grow the number of existing indirect and induced jobs.
- Long-term: Participation in strengthening the land-based Atlantic salmon farming sector will ensure that British Columbia continues to have strong employment in coastal communities.

* SOURCE: BC Salmon Farmers Association, *Economics Impacts of the BC Farm-Raised Salmon Industry - 2017 Update*, page 1.

LEADERSHIP

Concern: British Columbia and Canada can strengthen their roles as world leaders in sustainable aquaculture.

Reality: Aquaculture leadership will be best strengthened by accepting the evidence of industry and market trends, which are fueling land-based salmon aquaculture growth. This new sector is growing most rapidly in regions without existing open net-pen aquaculture industries, and this in itself will bring major transformation. The exception is Norway, which is actively advancing RAS in land-based aquaculture, and it would be wise for BC to follow Norway's lead. British Columbia has a window of opportunity to build on its first-mover advantage and inherent assets to become a world-leader in sustainable, low-risk land-based aquaculture. The choice is whether to be proactive in leveraging advantages, or to be reactive in trying to manage status-quo issues and the challenges of industry transformation that will inevitably be forced on us.

Again, change is inevitable, but we have a choice. We can have change imposed upon us, with the potential loss of the new opportunity - or we can embrace, manage and benefit from the change.