Offshore Aquaculture Economics: Implications for Seafood Market Growth

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06.27.19
Global aquaculture production growth remains rapid, no apparent barriers:

Global production 1970-2016
In contrast to fisheries, marine species are not very important in aquaculture, even if diadromous fish are counted as marine.

- **Freshwater fishes**: 59%
- **Molluscs**: 22%
- **Crustaceans**: 10%
- **Diadromous fishes**: 6%
- **Marine fishes**: 3%
This development strongly influence what is available at the U.S. Seafood market.

U.S. Seafood consumption of top 5 species

Pounds/capita


Canned Tuna
Catfish/Pangasius
Salmon
Shrimp
Tilapia
Why are freshwater fish (and molluscs) so popular in aquaculture?

1. Because it is relatively easy to keep control with the production process
   - This also tends to make production cost low
   - Most freshwater fish being farmed is relatively small, but with fast growth

2. Because production can take place close to the market
   - The U.S. is the only of the world’s 4 most populated countries which is not in the top for when it comes to aquaculture production
Why bother with marine fish?

1. Because they grow bigger and are more valuable, and even more so if they can be marketed as fresh

2. Because, in principle, they can be farmed in countries where people do not want to see the production process

2.5 Because the oceans are poorly utilized as a source for food, and there are lots of potential locations available (Gentry et al. 2017)
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But it is challenging, and costly
Marine aquaculture is a child of the 1960s, and was made possible with the invention of the netpen.
Technology developed rapidly, and the plants became larger.....
..... and larger
Innovations increase scale – a salmon pen from 1980 and one from 2015
And with increased knowledge and better technology, production cost came down: Global salmon production, price and production cost 1985-2016 (2016=1)
Netpens is a technology that require particular types of coastline, although they have become more robust.

For salmon, demand is sufficiently strong that even though production has increased rapidly, prices have had an increasing trend for over ten years.

Wild landings are stagnant for most species

- Increasing trend in prices in markets not dominated by aquaculture.

This is largely due to lack of access to new production cites, which is partly a regulatory and partly a technology question.

- A license to hold 780 mt of salmon in Norway is now worth more than 10 mill $

Two types of technologies are being tried: Offshore and land based.
Offshore aquaculture is happening for salmon and other species (as is landbased aquaculture)
This farm started operation in 2018. Its diameter is 110m and it will produce 8000 mt per year. Building cost: $100 mill.
This is 385m long and 65m wide with a capacity to produce 11000 mt. Has been built
Will become operative in 2019.
Construction cost is about $120 mill
Ocean aquaculture is expensive

These facilities are much bigger than coastal farms

This may not be necessary, but economies of scale makes it more likely that it will be economically viable

It also makes it easier to justify investments in supporting facilities

Depending on where you are in the world, it may also be necessary to handle weather issues
Production costs for alternative technologies for salmon: Before environmental costs and license issues

- **Conventional**: Coastal zone, open
  - 15-25 NOK/kg
  - High uncertainty! Guesstimates

- **Offshore/exposed, open**: 30-50 NOK/kg??

- **Land based**: 30-55 NOK/kg??

- **NOK per kg**
Production costs alternative technologies: Costs due to disease and other environmental issues

NOK per kg

Scenario 1
Low external costs

Diseases, salmon lice, etc.

15-25 NOK/kg

Diseases, salmon lice, etc.

30-50 NOK/kg

Diseases, salmon lice, etc.

30-55 NOK/kg

Conventional: Coastal zone, open

Offshore/exposed, open

Land based
Production costs alternative technologies: Costs due to disease and other environmental issues

- **High external costs**
  - Diseases, salmon lice, etc.
    - Conventional: Coastal zone, open - 15-25 NOK/kg
    - Offshore/exposed, open - 30-50 NOK/kg
    - Land based - 30-55 NOK/kg
And it becomes harder when there is additional fees associated with traditional technologies.

- Conventional: Coastal zone, open
  - Diseases, salmon lice, etc.: 15-25 NOK/kg
  - Other stakeholders: 30-50 NOK/kg

- Offshore/exposed, open
  - Diseases, salmon lice, etc.: 30-50 NOK/kg

- Land based
  - Other stakeholders: 30-55 NOK/kg
In Norway, real offshore fish farming is happening

It is largely caused by difficulties in getting traditional production sites

Capital costs are high, but while it is not obvious that they will come down to the level of a traditional set of pens, they are likely to come down

Distance to shore makes operation costs somewhat higher, but it does not make too much of a difference
  ◦ Also for traditional plants, the distance to the harvesting plant is significant

Variable costs, mostly feed, are basically the same

There are trails and a few operations other places in the world, but generally with smaller scale systems

In not too many years, there will be suppliers providing this kind of systems off-the-shelf
The development internationally increase the likelihood that aquaculture in the gulf will succeed

But it is still impeded by:

Not being able to buy fish of-the-shelf, and not to utilize existing breeding programs

Not being able to buy feed, vaccines etc. of the shelf

And the cost will be higher because one also have to invest in the infrastructure to serve the facilities since there does not exist an industry of well boats, feed producers etc.

But competition will be keen if one are producing species that are exposed to import competition, as globally, seafood availability continue to increase
So is this the future?
Will one move to a more controlled environment?