Organic Aquaculture: Principles, strategies and environmental impact

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• Global production and market share
• Aquaculture: The blue revolution
• Organic Aquaculture in Europe and Germany
• Consumer expectations - Organic Standards
• Environmental Impact
Importance of Fish for Food supply
FAO Food Balance Sheets 1997 - 1999

• More food fish and seafood being consumed than any other type of meat.

• Total animal protein comes from
  - 15.9 % food fish (from aquaculture and capture fisheries)
  - 15.2 % pork
  - 13.4 % beef
  - 13.0 % poultry meat.

• In Africa and Asia much more fish than in other regions of the world.

• Greater consumption of fish because of their lower price and greater affordability.
Fish production worldwide: nowadays 50% from aquaculture
Aquaculture predominantly in developing countries booming
Global Farmed Meat Production 2005
(to calculate animal protein in total add milk and eggs)

308 million tons

- **Beef** 32%
- **Pork** 21%
- **Aqua­culture** 16%
- **Sheep & Goat** 5%
- **Poultry** 26%

Currently fastest growing food producing sector.

1950: 17 kg per Person
47 million tons

2005: 40 kg per Person without fish
260 million tons

Data: FAO 2005, Earth Policy Institute 2006
www.earth-policy-org/books/pb2/pb2ch9_222s.htm
Efficiency of grain to protein conversion

grain (cereal, maize, soybean, ..) kg : kg meat

- Beef
  - 7:1 US feedlot
  - 0:1 Grass-based
- Pork
  - 4:1
- Aquaculture
  - < 2:1 US catfish
- Poultry
  - > 2:1
Aquacultural production in China

- **Finfish** (mostly *carp*), inland *freshwater* ponds, lakes, reservoirs, rice paddies.

- **Shellfish** (mostly *oysters*, *clams*, and *mussels*), mostly in *coastal regions*.

- **Aquaculture** often integrated with *Agriculture*.
  (enabling farmers to use agricultural wastes, such as pig or duck manure, to fertilize ponds, thus stimulating the growth of plankton on which the fish feed).

- **Fish polyculture** widely practiced in China and India.

- Land and water for fish ponds become scarce
  => feed more grain concentrates
  => raised pond yield per hectare from 2.4 tons of fish in 1990 to 4.1 tons in 1996.
The problem with Salmon and Shrimps

• Both: 3.6 million tons = 9% of the global farmed fish, but growing fast.

• **Salmon**, a **carnivorous** species, inefficient because fed with other fish, which comes either from fish processing plant wastes or from low-value fish caught specifically for this purpose.

• **Shrimp** farming often **destruction of coastal mangrove forests**.

• **World aquaculture** dominated by **herbivorous** species
  - mainly **carp** (in China and India),
  - **catfish** in the United States and
  - **tilapia** in several countries and
  - **shellfish**.

• Great growth potential for **efficient animal protein production**.
Salmon: Worldwide Trade and Aquaculture

in 1,000 MT


- Trade
- Aquaculture Production

Josupeit, H. & N. Franz, FAO Fisheries Dep., Bremen 20 Jan 2004
Salmon aquaculture organic?

- Over 73 percent of farmed finfish production within developed countries.
- **Carnivorous fish** species such as salmon and trout.

- Organic aquaculture based on own organic feed and nutrient resources:
  - Use or not of fish meal and fish oil within organic feeds for these species?
  - What the maximum level of fish meal or fish oil be used within certified organic feeds?
  - Transfer of essential protein and lipid sources from one part of the globe to the other?
  - Ethics and long term sustainability of producing organic carnivorous fish species?
Shrimps: Worldwide Trade and aquaculture

in 1,000 MT


Trade Aquaculture Production

Josupeit, H. & N. Franz, FAO Fisheries Dep., Bremen 20 Jan 2004
Problems of intensive shrimp aquaculture => organic

• Pollution and over fishing caused a great reduction of the natural fishing population sufficient supply of fish and seafood no longer guaranteed.

• **Intensive aquaculture** causes various **environmental problems:**
  - Devastation of precious **mangrove forests** resulting damage to the livelihoods of fishing communities which depend on mangroves as nursery areas for fish stocks.
  - Uncontrollable **accumulation of nutrients and pesticides**.
  - Use of **antibiotics** with risk of build-up of resistance against pathogens (farmed organisms and consumer).

• **Shrimps** produced in south-east Asia and Latin America. **Thailand** and **Ecuador** world's biggest producers of shrimps (*P. monodon* and *P. vannamei*).

• Increase in aquacultural production negative socio-economic and ecological effects. **Boycott** campaigns for aquacultural products by environmental bodies and NGOs.

• Standards for **organic** shrimp production began in the late 1990s by Naturland et al. in the year **2000 first organic shrimps** in **Ecuador, Java** and **Vietnam** in conversion.
Organic Aquaculture in Germany

- Biggest market for organic aquaculture products (regarding turnover of products) followed by GB and CH.
- Predominantly organic salmon and shrimp.
- Domestic production only 3% of worldwide 9,000 t.
Organic Aquaculture in Germany II
– a status quo analysis of the industry

- **Organic Aquaculture** of high interest for the international fishery industry,

- but German aquaculture farms hardly participate. **Small enterprises** face several obstacles: suitable marketing channels, small amounts, irregular supply and high prices from the producer side, lack of quality of organic salmonid feed, demanding certification process (inspection costs, documentation).

- **Big international companies** (mostly >100 t/a), dominate, based on integration of total chain (including farming, processing, export, partly feedstuff) and professional management: market analyses, marketing measures (e.g. trade show presentations) prepare the product launch, calculation are done long-term, volume of production favours stable business relations between suppliers and clients.
Organic Aquaculture in Europe

- **5,000 tonnes** total production in 2000
  (0.01% of global or about 0.25% of European aquaculture production)

- **4,000 tonnes** of **salmon**
  (Irish and Scottish farms for sale to western Europe)

- **200 - 400 tonnes** of **carp** and
  accompanying freshwater species such as tench (Austrian and German farms)

- **100 - 200 tonnes** of **trout** (Scottish and German farms)

- **100 tonnes** of **blue mussels**
  (produced from one Irish farm for sale in Germany).

Non-European countries developing **organic aquaculture**:

- **Salmon**: Australia, Canada, USA, (Chile)
- **Shrimp**: Ecuador, Peru, Indonesia, Thailand, Vietnam
- **Mussels**: New Zealand
- Several (Tilapia etc.): USA
Standards

Consumers expectation for Organic Salmon
(Market assessment survey, Canada, B.C., n = 115, in 2000 - 2001)

- > 93% protect and maintain the quality of surrounding **environment**
- > **sustainable** fisheries and natural (or organic) **feed** ingredients
- > 93% **no GMO**
- > 91% cultivation of only **indigenous species**
- > 80% **no antibiotics**

Cho, G.K. & J.W. Heath, Proceed. 14th IFOAM Congress, p 130
Consumers expectation for Organic Aquaculture in the US

- Major advantage of *organic fish/shellfish* for consumer in the US
  - 95% chemical/pesticide free
  - 87% antibiotic free
  - 62% superior flavor
  - 59% ecologically sound
  - 59% better quality

- 27% prefer wild-caught seafood: "Wild seems more natural"

- > 50% unfamiliar with aquaculture, particularly the way of keeping the fish in cages often confusion.

- Many express concerns about the crowded conditions in aquaculture facilities and the quality of water, also about fish feed, the diets being unnatural

Boehmer, S., M. Gold, S., Hauser, B. Thomas, A. Young (USDA) 2005, AFSIC Notes #5
Organic Standards I

Aquaculture <-> Agriculture

- **Room to swim properly** = **lower stress** (all organic livestock regulations)
  e.g., Scotland / Ireland Salmon farm stocking density:
  - Conventional: 25 - 30 kg fish/m³ (small cages)
  - Organic: 5 - 10 kg fish/m³

- **Resemble the natural habitat** (e.g., cages in strong sea currents)

- **Choice of species - stock development**
  Use of adapted (indigenous) species for the system.
Organic Standards I

Aquaculture <-> Agriculture

- **No chemicals**
  No pesticides to control parasites and other problems from very densely stocked fish.
  No chemical growth promoters (hormons) and antibiotics.

- **Special feed**
  Feed from organic (e.g. cereal) or at least sustainable sources (pellets of Hering & Mackerel caught for human consumption for Salmon).
  No GMO. No artificial colourants.

- **Processing according organic standards** (no chemicals, no GMO, etc.).

- **Environmental Impact**
  Keep impact on the environment and aquatic ecosystems low or beneficial.

Graig Farm Organics - organic farmed salmon www.graigfarm.co.uk
www.kinvarasmokedsalmon.com/organic
P and N flow model of a salmon farm

Feed input
7.7 % N
0.9 % P

Feed uptake
80%

Feed losses
20%

Retention (fish)
25 % of N fed
30 % of P fed

Excrements (solid)
10 % of N fed
54 % of P fed

Excrements (dissolved)
65 % of N fed
16 % of P fed

Feed uptake
80%

Organic Aquaculture will increase **240-fold**
from 5 000 tonnes in 2000 to
1.2 million tonnes by 2030
(0.6 % of global production in 2030).

**Total world aquaculture**
will increase **4-fold**
from 45 million tonnes in 2000 to
over 194 million tonnes by 2030.

Estimates based on existing organic aquaculture **production levels** from developed countries, and the **major markets** for organic aquatic products:

**Europe & North America, Australia, Japan, New Zealand & Singapore.**
Conclusion

- Aquaculture production will further increase, particularly organic!
- Efficiency high, but for carnivorous fish low (Salmon, Trout).
- Standards Organic Aquaculture similar to Agriculture.
- Developing organic agriculture by focusing efficiency, environmental impact and "organic" principles.