Innovations for sustainable intensification of freshwater aquaculture in Hungary

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Is there potential for development of freshwater aquaculture in the EU?

Production of fish in the world

<table>
<thead>
<tr>
<th>Type</th>
<th>Aquaculture (Mt)</th>
<th>Capture/wild harvest (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>FSC inland</td>
<td>48.8 (63.7%)</td>
<td>11.5</td>
</tr>
<tr>
<td>FSC marine</td>
<td>27.8 (36.3%)</td>
<td>81.2</td>
</tr>
<tr>
<td>Fish inland</td>
<td>44.1</td>
<td>10.6</td>
</tr>
<tr>
<td>Fish marine</td>
<td>2.9</td>
<td>67.5</td>
</tr>
</tbody>
</table>

FSC = Fish; Shellfish; Crustacea

International landscape of fisheries and aquaculture

<table>
<thead>
<tr>
<th>Position</th>
<th>Fisheries (Mt)</th>
<th>Aquaculture (Mt)</th>
</tr>
</thead>
<tbody>
<tr>
<td>#1</td>
<td>China 17.6</td>
<td>China 47.6</td>
</tr>
<tr>
<td>#2</td>
<td>Indonesia 6.5</td>
<td>India 5.2</td>
</tr>
<tr>
<td>#3</td>
<td>USA 5.0</td>
<td>Indonesia 4.3</td>
</tr>
<tr>
<td>#4</td>
<td>India 4.8</td>
<td>Vietnam 3.4</td>
</tr>
<tr>
<td>#5</td>
<td>Peru 4.8</td>
<td>Bangladesh 2.1</td>
</tr>
<tr>
<td>#6</td>
<td>Russia 4.6</td>
<td>Norway 1.4</td>
</tr>
<tr>
<td>#7</td>
<td>Japan 3.5</td>
<td>Egypt 1.2</td>
</tr>
<tr>
<td>#8</td>
<td>Chile 3.0</td>
<td>Myanmar 1.0</td>
</tr>
<tr>
<td>#9</td>
<td>Vietnam 2.8</td>
<td>Chile 1.0</td>
</tr>
<tr>
<td>#10</td>
<td>Norway 2.3</td>
<td>Thailand 0.9</td>
</tr>
</tbody>
</table>

Source: EUMOFA 2018
Aquaculture in the EU

Total European aquaculture production: 1 292 597 t

Marine: 77.8% (1 006 035 t)
Freshwater: 22.2% (286 563 t)

Aquaculture = 100%

Common Carp 72 912 t 25.4%
Rainbow Trout 156 762 t 54.7%
Other sp. 56 887 t 19.9%

Source: FAO Fishstat Plus, 2016
Trends of the carp production in the EU

Common carp production in the EU:

- Significance part of production in Central Europe
- Production of Western European countries has been steadily decreasing
- Production in Central and Eastern Europe is slightly increasing

Lessons should be learned from the experiences of the decline in Western European production!

Source: FAO Fishstat, 2018
Aquaculture in Hungary

- Pond aquaculture contributes to 81% of Hungarian aquaculture production
- The Common carp production 67%
- Stagnating pond aquaculture – increasing intensive production
The pond ecosystem

Natural wetland
- Fishponds has artificial origin. The water supply is also artificial (by gravity, or by pump) in decisive part.
- Comparable nutrient cycling processes.
- Artificially high nutrient level that will be removed by the harvested fish.
- It results steady state, and high biomass in every level of food chain all over the vegetation period.
- Planktonic predominance that maintained by the carp stock.
- Typical mosaic-complex that develops by the results of periodic water filling and drainage.

Fish pond

(Halasi-Kovács 2012)
Additional natural values of pond aquaculture

- Pond aquaculture maintains 26,000 ha natural-like wetlands in Hungary
- Pond fish farms contribute to preserve biodiversity:
  - More than 400 bird species, most of them with NATURA 2000 importance
  - Significance part of the otter population in Europe
  - Numerous wetland related plant and animal species with European significance
Additional environmental values of pond aquaculture

- Pond fish farms contribute to better water management.
  - Retention of water
  - Retention of soluble and floating compartments in supply water

1 ha pond in one year retains:

- 3.8 – 8.4 kg Phosphorous
- 96 – 560 kg Nitrogen
- 1100 – 1600 kg Suspended Solids

(Knösche et al. 2000)
Pond fish farms contribute to achieving the EU environmental policies.

**NATURA 2000** is the centrepiece of EU nature & biodiversity policy. The aim of the network is to assure long-term survival of Europe’s most valuable and threatened species and habitats. It is an EU-wide network of nature protection areas established under the 1992 Habitats Directive.


**NON PRODUCTION FUNCTION OF FISH PONDS:**
- Providing important habitats for flora and fauna;
- Maintainence of Biodiversity;

**FUNCTIONS:**
- Improve water management;
- Receive flood waters and sustain water in the landscape.
Challenges for pond aquaculture

Climate change
- Decreasing renewable water resources
- Extreme flow regime (low and high level)

Economic changes
- Increasing salary costs, results lack of employees
- Competition with agricultural sector
Strengthens and weaknesses

- Historic traditions
- High genetic potential
- High technological potential
- Low-input aquaculture
- Natural and environmental values
- Recreational value
- Role in employment

- High labour intensity
- Lack of automatization
- High investment costs
- Low productivity
- Uncertain quality
- Low efficiency in post harvest chain
Solutions suggested by researchers

- Sustainable intensification is required
- Innovation in technology
- Accept and support the additional costs of natural value maintenance
Sustainable intensification of pond aquaculture

Intensive carp production in small size ponds or tanks

• Stocking high quality fingerling with high stocking density.
• Applying high quality feed distributed by automatic feeder.
• Providing aeration, based on regular water quality monitoring.
• Protection from predators and poaching.
• Total yield: 10 t/ha.
Sustainable intensification of pond aquaculture

Combined Intensive-Extensive Production

- Combine the principles of extensive pond farming and intensive technology.
- Carp production, predator production, biculture production (pikeperch/sterlet)
- Water quality control (oxygen, ammonia).
- Total yield: ~20 kg/m$^3$
Sustainable intensification of pond aquaculture

RAS – pond system

Intensive rearing and fingerling production in RAS  Extensive market-size fish production in pond
Multi-functional pond fish farming

Higher and diversified farm income

Additional employment opportunities
New species in intensive systems

Pikeperch (*Sander lucioperca*)

- Development of offseasonal rearing technology
- Work out the technology of intensive nursery (special equipments, special processing)
- Applying probiotics feeding larvae
- Development of outgrowing technology in controlled pond in pond system.
- Development of broodstock technology (feeding and technology elements)

As a results of the research programs the intensive production technology of the pikeperch can be introduced at farm level as well. Good and controlled quality native fish reach the consumers cheaper than the current one.
European catfish (*Silurus glanis*)

- Development of intensive production technology
- Introduce a breeding program (intensive technology tolerant, fast growing, disease resistance, better meat quality strains)
- Work out different way of intensive-extensive production
Supporting the maintenance of natural values

- Pond aquaculture technology can be summarized as a complex value, important for nature conservation, water management and social-economic aspects as well.
- Providing EMFF subsidy for this technology highly recommended for the sustainability of wetlands and their associated values resulting from the fish pond management.
- The subsidy can be interpreted as supporting wetlands, rewarding „blue pond” technologies and best management practices.
- Suggested support would be 300 EUR/ha/year for 5 years.
Main conclusions

- Freshwater pond fish farming is a unique segment of European aquaculture.

- Pond aquaculture is a good example for natural resources renewing technology and the circular economy.

- Pond fish farms besides producing fish provide ecosystem services and contribute to achieve the goals of NATURA 2000 and WFD.

- Pond aquaculture requires sustainable intensification and support for maintaining the additional costs of natural values that resulted by operation.

- The pond aquaculture has great potential utilized the results of necessary improvements.
Thank you for your attention!

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