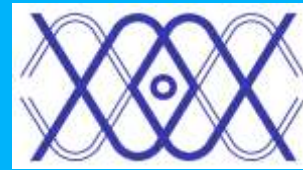


# Sustainable intensification: ecosystem services combining fish production

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# Fishponds: constructed wetlands in the drying landscape



- Fishponds are man-made constructions with special structures for filling and draining of utilized surface water and harvesting fishes.
- About 400,000 ha constructed wetland areas are created and maintained by pond farming in the EU.

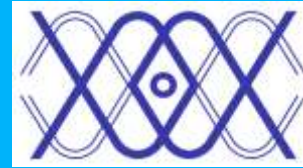
The Körös-Valley at Biharugra  
Map of the 1<sup>st</sup> military survey in Hungary (1782-1785)  
([www.maps.arcanum.com](http://www.maps.arcanum.com))



The Körös-Valley at Biharugra  
Satellite map (recent)  
([www.maps.arcanum.com](http://www.maps.arcanum.com))



# The fishpond ecosystem



## Similarities with natural wetlands

- Nutrient cycling identical than natural semistatic wetlands.
- Similar in complexity to the natural aquatic ecological systems.

## Differences from natural wetlands

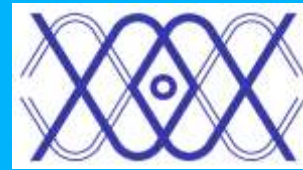
- Dominance of planktonic organisms that rely on the dissolved nutrients.
- Increased nutrient level, which is removed by produced fishes, resulting more stable ecological system.

## Consequences

- The increased nutrient input enhances the population sizes of all elements of the food web.
- The biological basis of this status is the activity of stocked Common Carp population.
- The intensity of pond farming technology is limited.



# Ecosystem services of fishponds



- **Regulating and maintaining services of fishponds**
  - CO<sub>2</sub> absorption/Global climate regulation,
  - Microclimate regulation,
  - Air quality regulation,
  - Water quality regulation,
  - Water storage, water retention,
- **Provisioning services**
  - Fish production
  - Reed production
  - Livestock and crop production
- **Cultural services**
  - Recreational opportunities/ Ecotourism
  - Cultural heritage
  - Environmental education
  - Aesthetics
  - Opportunity for research



# The sustainable intensification of pond farming: combining intensive extensive systems

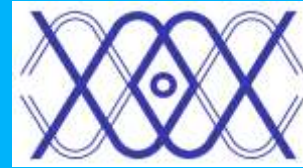


## Raceway in pond – Cage in pond – RAS-pond systems

- Enhanced production of low trophic species: more intensive and shorter production cycle of Cyprinids.
- Combining intensive (ca. 10-100 kg/m<sup>3</sup>) valuable fish production with extensive (ca. 0.08-0.15 kg/m<sup>3</sup>) low trophic species farming:
  - Trout and Cyprinid;
  - Percid and Cyprinid;
  - Percid/Sturgeon biculture and Cyprinid.
- Combining intensive valuable fish production with primary producers (e.g. waterweeds, energy plants)
- Strengthen circularity in the whole system.
- Lower investment and operating costs.



# The circular aquaculture production model

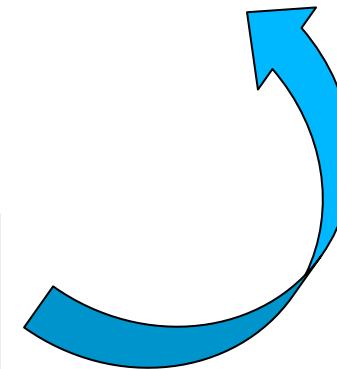
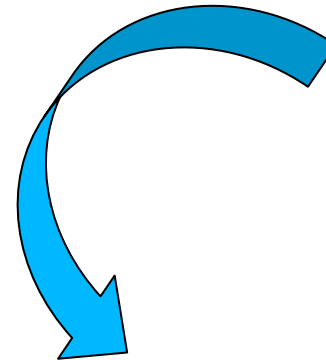


## Intensive system: place of production

- High density mass production (for market)
- Discharge of wastewater with high concentration of nutrients.
- Better work organization.

## Extensive system: place of nature

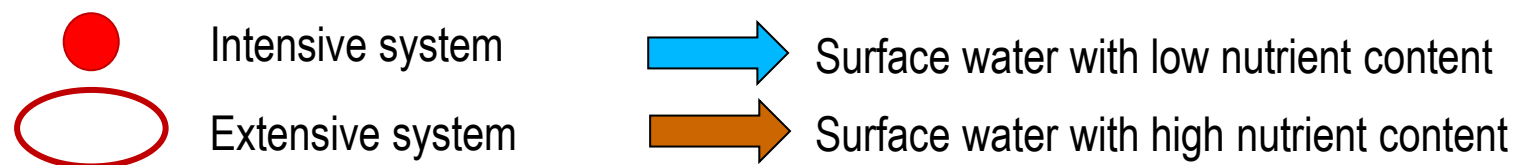
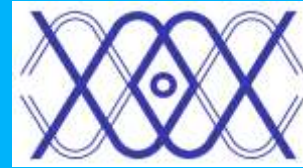
- Low density production (e.g. restocking)
- Retention of water, sediment and nutrient.
- Nutrient transformation to fish.
- Nutrient transformation to enhanced food web.
- Operation results ecosystem services.



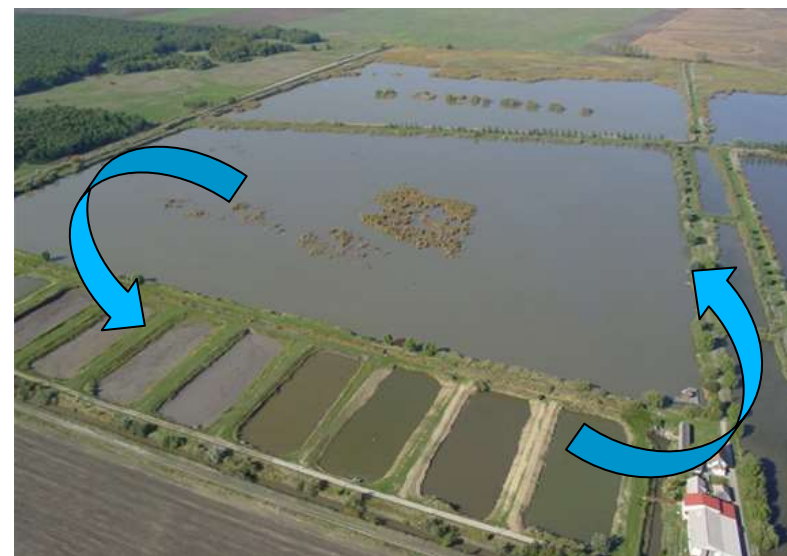
## Natural waterbody

- Economical water use.
- Reduced concentration of sediment and nutrients.
- Sustainable fisheries and water management

# The circular aquaculture production model in the HAKI



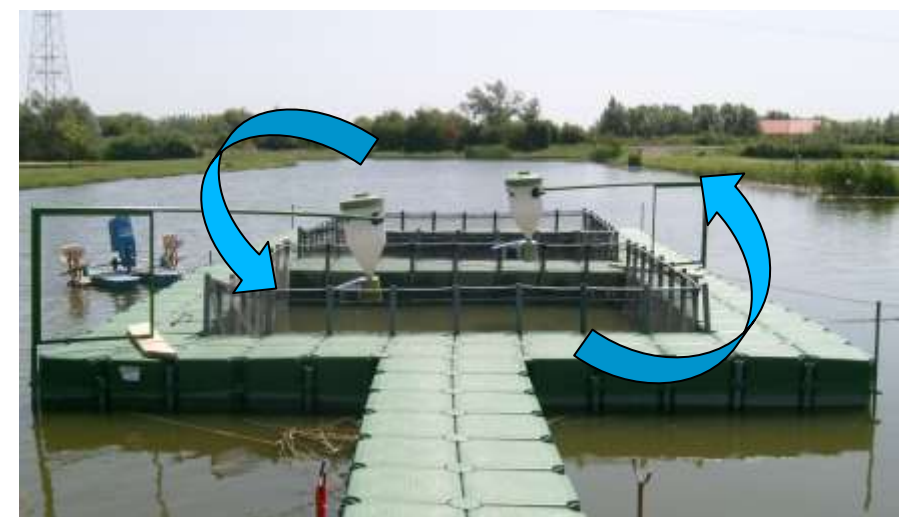
# The circular aquaculture production model in commercial fish farms



Fish pond water recirculation between intensive and extensive ponds



Raceway in pond



Cage in pond



A sunset scene over a body of water. The sun is low on the horizon, creating a bright orange and yellow glow that reflects on the water's surface. The sky is filled with soft, wispy clouds in shades of orange, red, and brown. In the foreground, the dark silhouettes of reeds or grasses are visible, partially obscuring the water.

**Thank you for your  
attention!**

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