‘Halophyte filters’: the potential of using halophyte species for phytoremediation purposes in saline aquaculture

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Worldwide consumer demand for food

- Seafood as protein source
- Overexploitation of oceans
- Need for sustainable production
- Aquaculture as solution

Aquaculture

- From hunting and gathering to farming
- Marine species often cultured in open sea
  - salmon and shrimp
  - marine aquaculture = 20% of marine demand
- Freshwater species often land-based
  - carp and tilapia
  - freshwater aquaculture = 75% of freshwater demand

Land-based aquaculture vs. open sea cultures

- Advantages of land-based cultures
  - input and output flows can be better managed
  - less risk of escape of (exotic) species
  - less risk of transfer of pathogens or genes between cultured and wild species
  - less risk of ecosystem degradation

- Disadvantages of both culture types
  - nutrient waste !
  - use of fishmeal and fish oil

Potential for saline cultures

- Freshwater is scarce at many delta and coastal areas
- Increasing pressure on freshwater supply
- Saline cultures may be appropriate solution

- To be sustainable, the disadvantages need to be tackled
- What can be done about nutrient waste?




Let nature work for you !

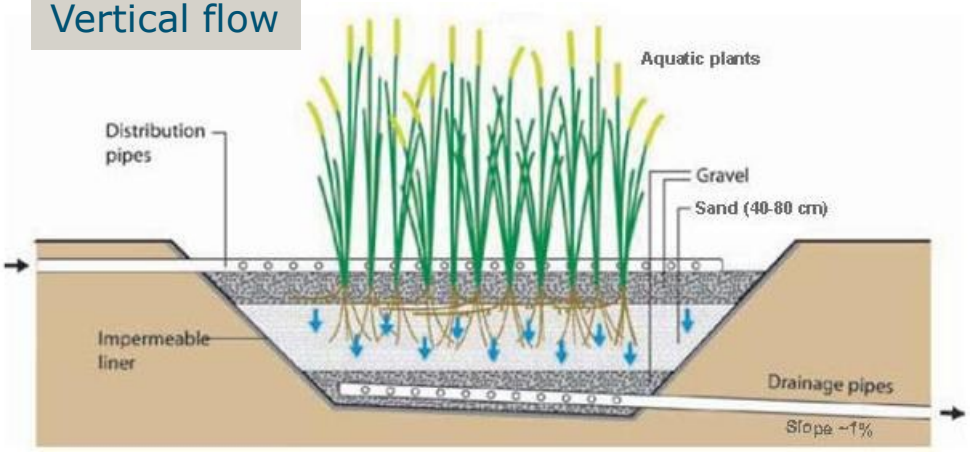
- Water purification by vegetation

- Constructed wetlands or helophyte filters
  - ample freshwater experience
  - esp. removal of nutrients, suspended solids, and BOD

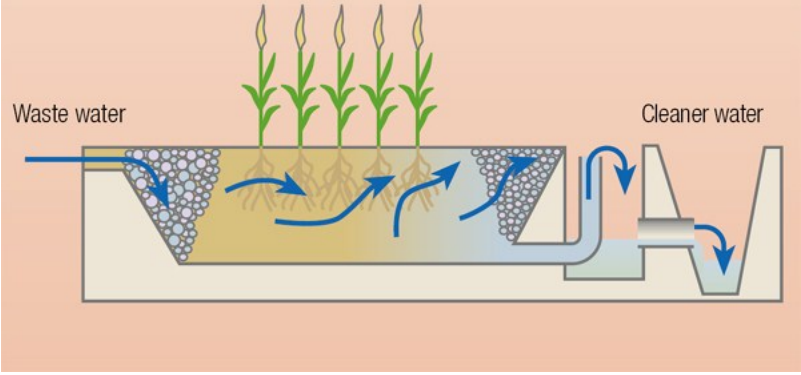
- Phytoremediation
  - marine experience
  - esp. removal of metals and organic contaminants

Types of constructed wetlands

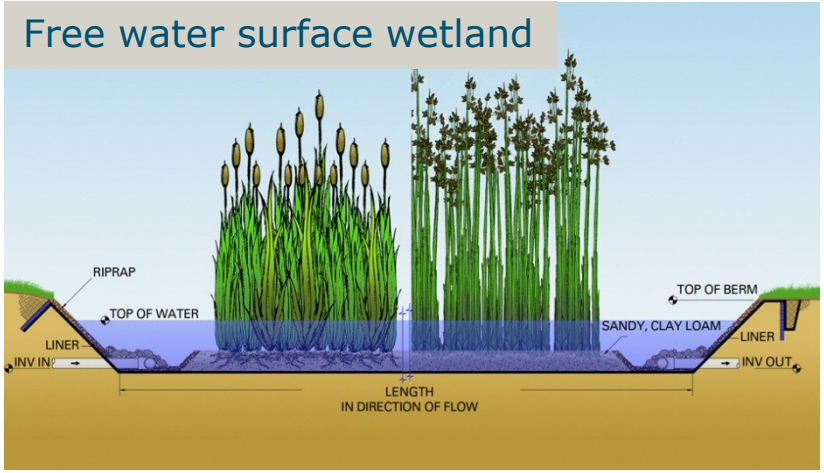
Vertical flow



Horizontal subsubsurface flow



Free water surface wetland



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Processes and mechanisms

- Nitrogen removal depends on oxygenation
- Phosphorus retention by storage in sediment and plant biomass
- Metal tolerance similar physiology as salt tolerance

- Design of wetland governs the processes
- Removal efficiencies are related with level of control
- For aquaculture effluent N reduction 50-90 %, P reduction 5-90 %

How can this be applied in aquaculture ?

- Recirculating aquaculture systems
- Integrated mariculture
- Combined wetland
- Traditional wetland

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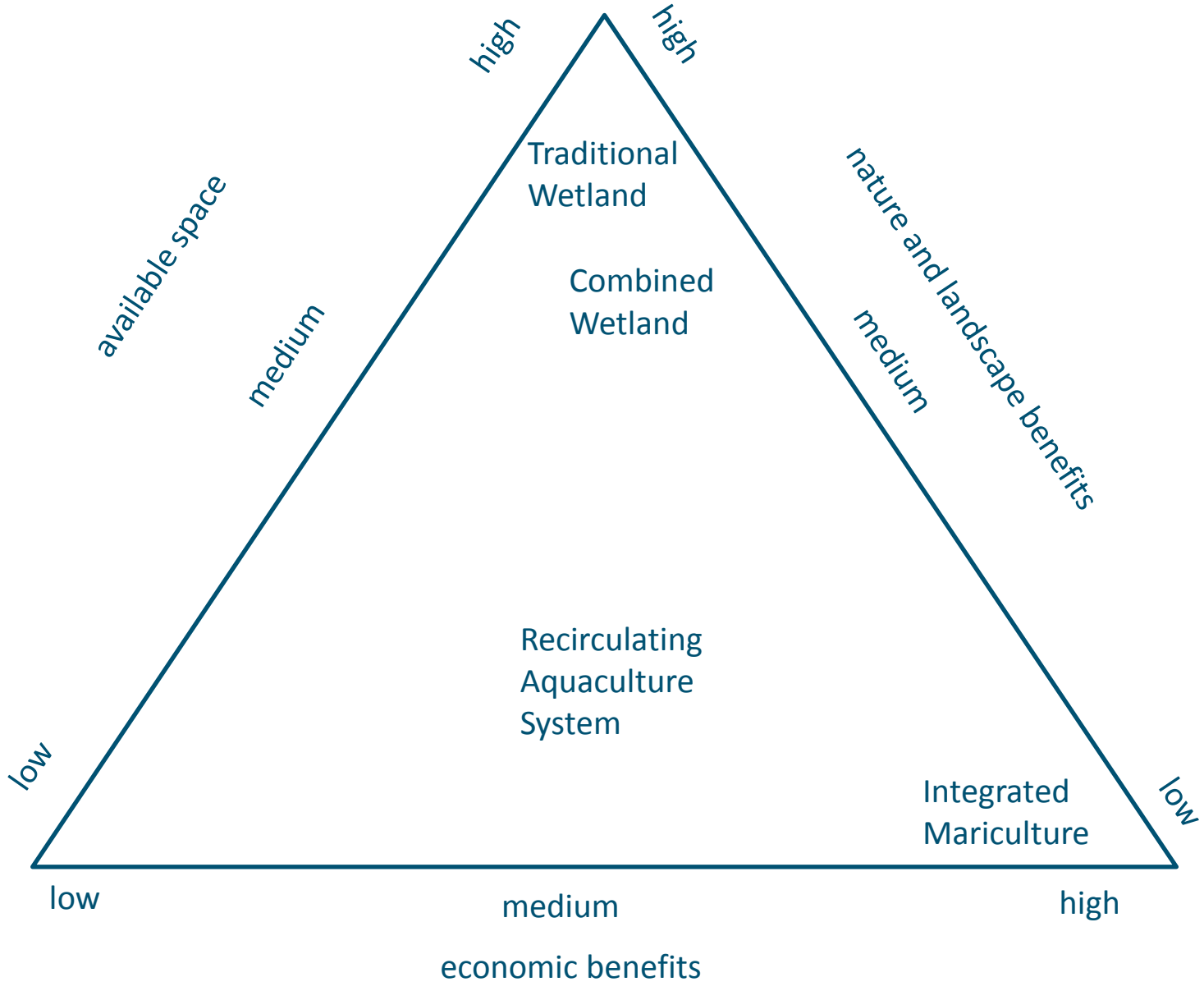
Potential of halophyte filters

- Closing nutrient cycles in saline cultures
  - turning waste into resource
- Economic benefits
  - biomass for chemicals, energy, insolation, roofing
  - edible species for animal or human consumption
- Ecological benefits
  - diversity of plants, birds and other wildlife
  - nature compensation
  - attractive landscape elements



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Dutch case study

- Province of Zeeland (southwestern delta)
- Transition zones between estuarine nature and agricultural hinterland
- Regional government promotes land-based aquaculture
- Clean saline water available
- Tidal creeks and ‘inlagen’

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Lessons learned (so far)

- Three parties play a role
  - Business to culture fish
  - Government to set the boundaries
  - Academia to provide scientific background

Conclusions

- Halophyte filters offer potentially a good solution to utilize aquaculture effluent
- Design depends on available space and needs
- Halophyte filters offer opportunity for uncoupling freshwater and saline water cycles
- Added value in areas with increased salinization and anthropogenic impact
- Pesticides and other contaminants can also be reduced by halophyte filters



Thanks for your attention

Questions ?

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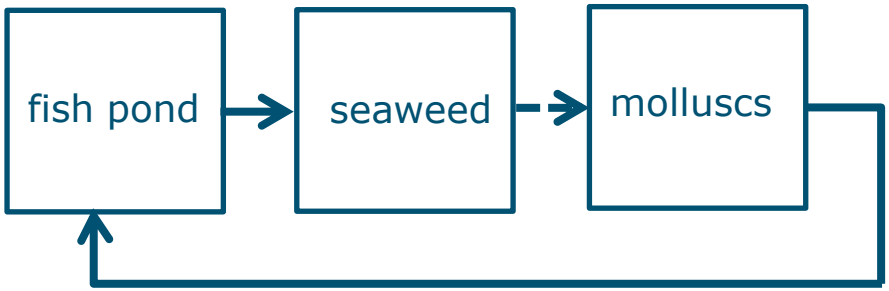
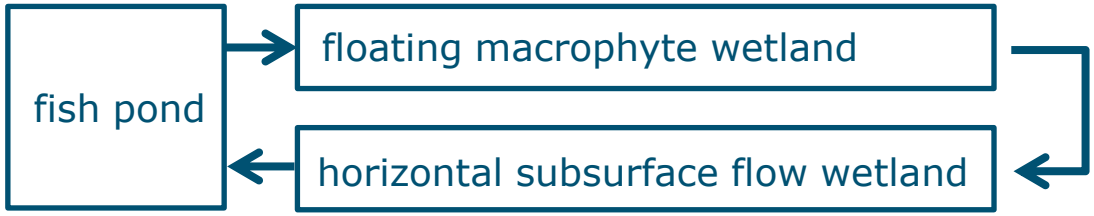
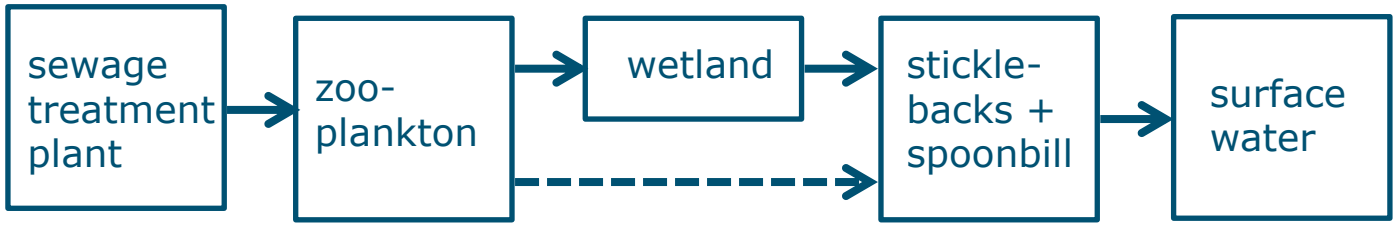

fish pond
seaweed
molluscs


fish pond
floating macrophyte wetland
horizontal subsurface flow wetland


sewage treatment plant
zoo-plankton
wetland
stickle-backs + spoonbill
surface water


fish pond
wetland
surface water