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*Publication date:*  
2015

*Document Version*  
Peer reviewed version

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*Citation (APA):*

Holdt, S. L. (2015). The Commercial IMTA and Future Seaweed Biofilter Potential in Denmark [Sound/Visual production (digital)]. 5th Congress of the International Society for Applied Phycology, Sydney, Australia, 22/06/2014

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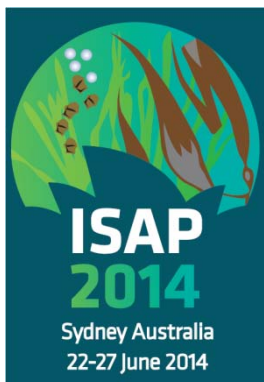
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# THE COMMERCIAL IMTA AND FUTURE SEAWEED BIOFILTER POTENTIAL IN DENMARK

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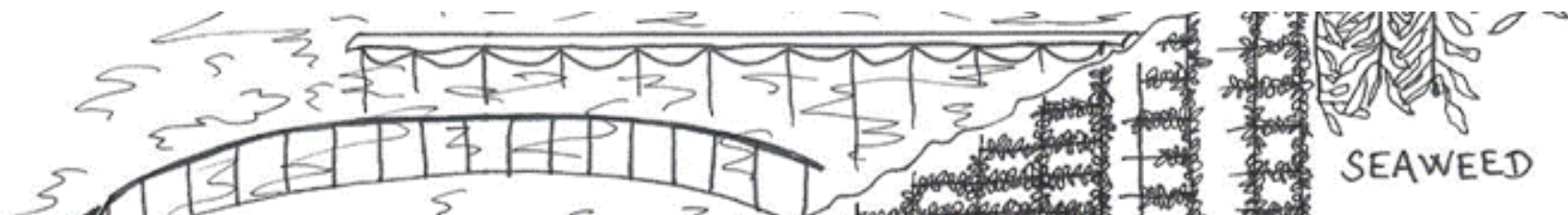
National Food Institute

[suho@food.dtu.dk](mailto:suho@food.dtu.dk)



# Objectives

- Nitrogen and regulations in DK
- IMTA
- Cast seaweed
- Seaweed for waste water bioremediation
- Future perspectives

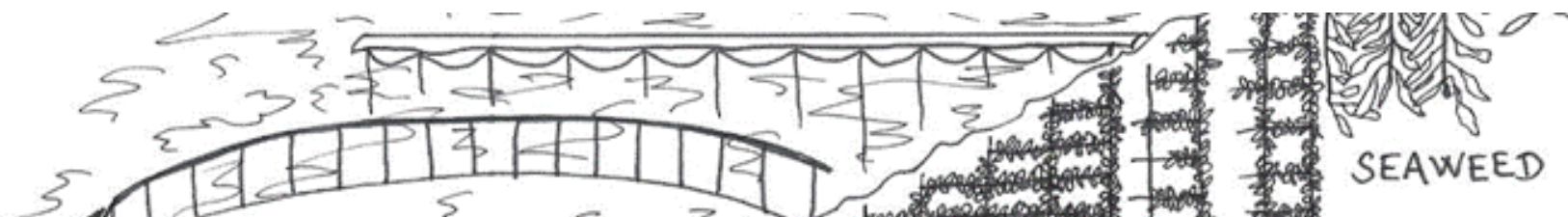
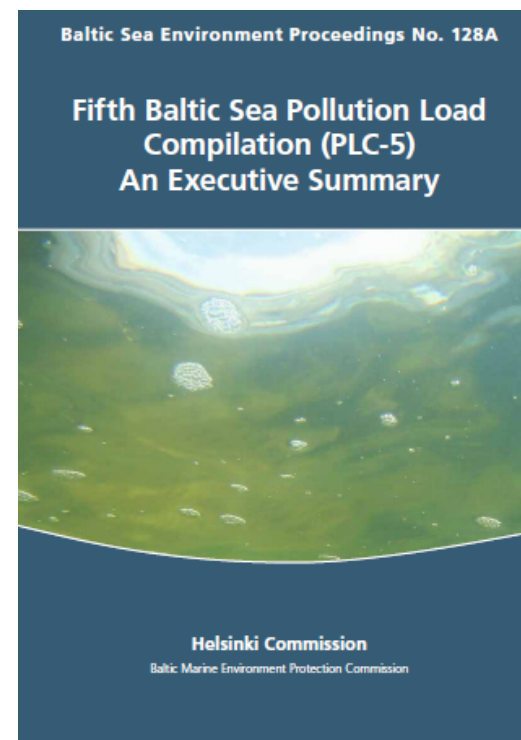


# Intro

Danish sea territory 100,000 km<sup>2</sup>

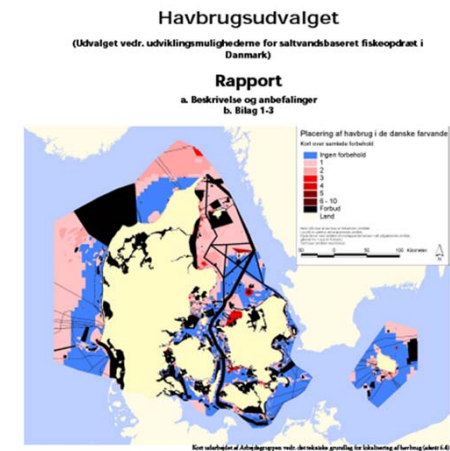
## Total Danish N loading

- 43,000 t/year
  - the terrestrial input is the main contributor
- 350 t/year from marine farms
  - Environmental concern



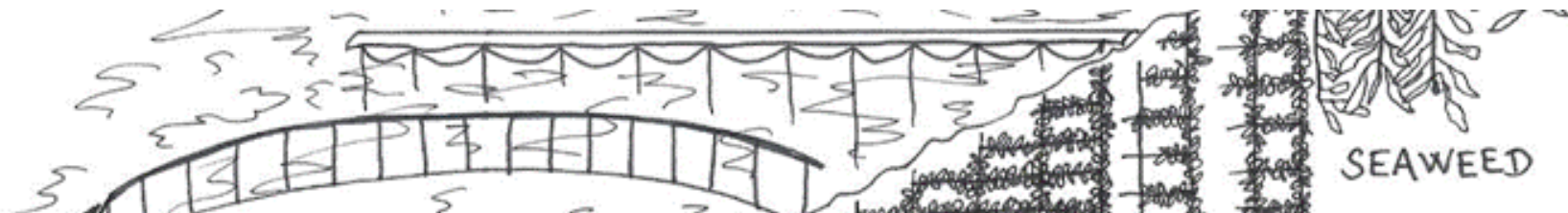
# Restrictions

- Generally the water areas are not allowed to increase their N outputs
- EU Water framework directive
- The new aquaculture strategy has just ended the public hearing period
  - propose 50% increase in Danish aquaculture with best available technologies (BAT) (2020)
  - the use of biofilter (mussels and seaweed)



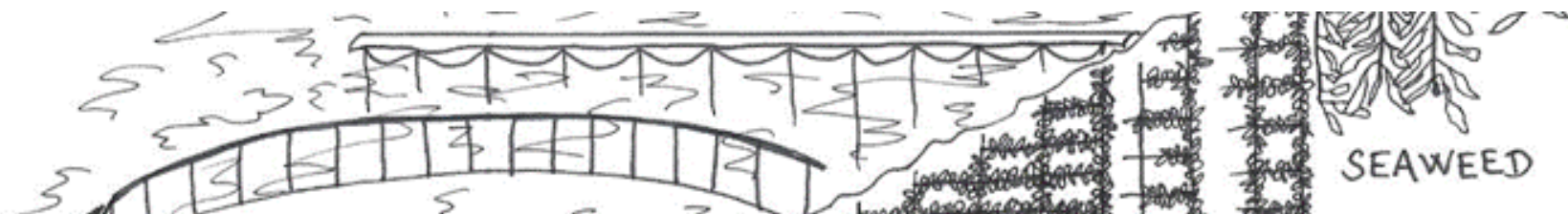
Marts 2003

Ministeriet for Fødevarer, Landbrug og Fiskeri

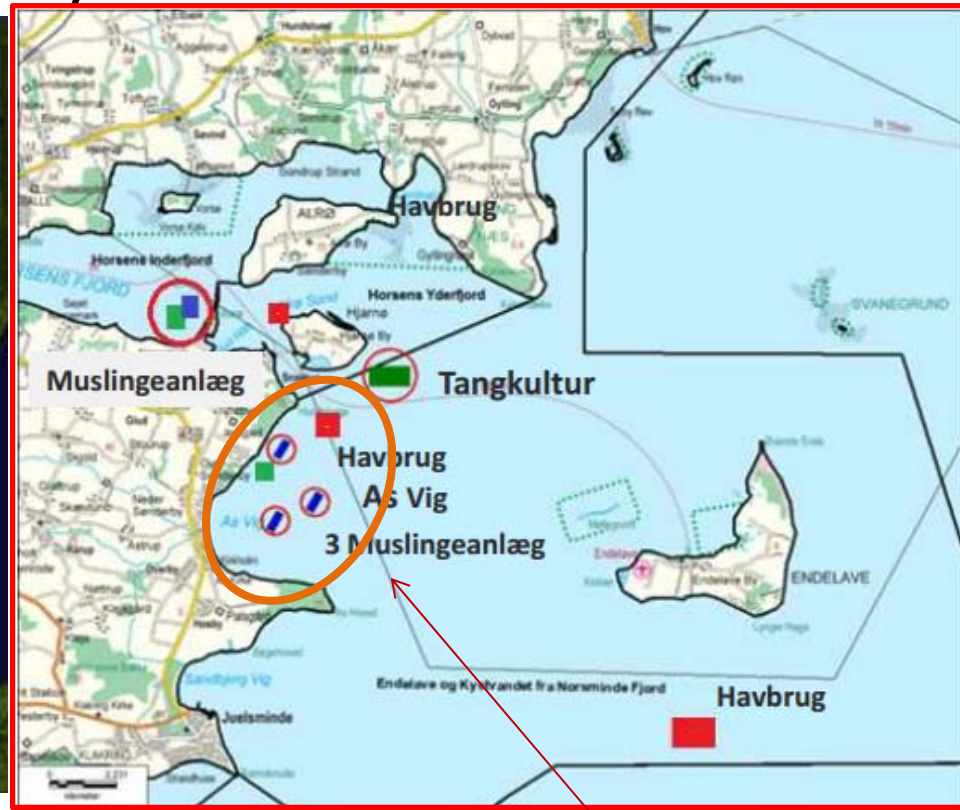


# Integrated Multi-trophic Aquaculture (IMTA)

- Hjørnø fishfarm commercial scale IMTA
- 27 people fully employed (20 x-tra Oct-Jan)
- Rainbow trout production 175 t/y
- 35 SmartFarms (harvest 2012: 143 t)
- 10 km of *Saccharina latissima* droppers
- Organic certified seaweed at 'reference site' (100 ha)



- IMTA (Hjarnø fishfarm)



Fish farm

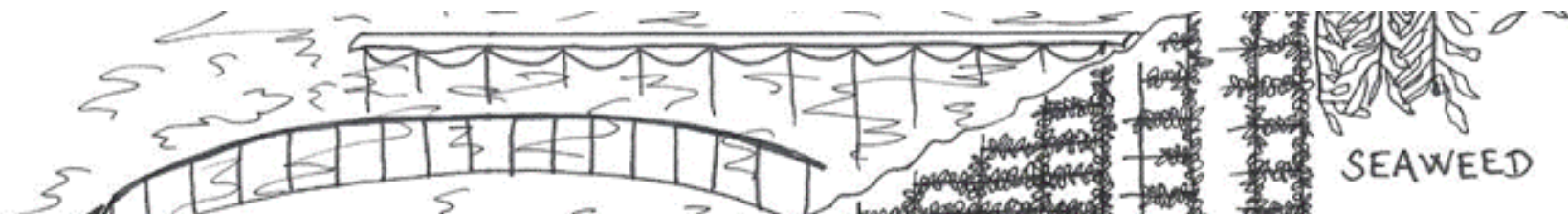


Seaweed farm

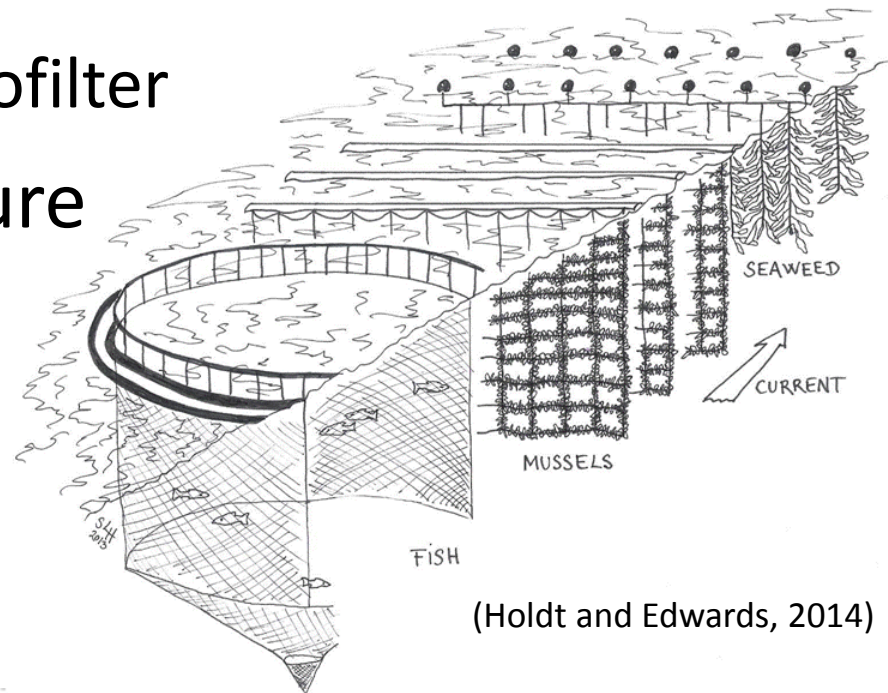


Mussel farm

**IMTA**



- Compensation study/combined cultivation
  - Document the biofilter efficiency (N and P uptake)
- New facility, 2,200 ton rainbow trout
  - Zero N output
  - Mussel and seaweed biofilter
- Decoupled - > polyculture



(Holdt and Edwards, 2014)

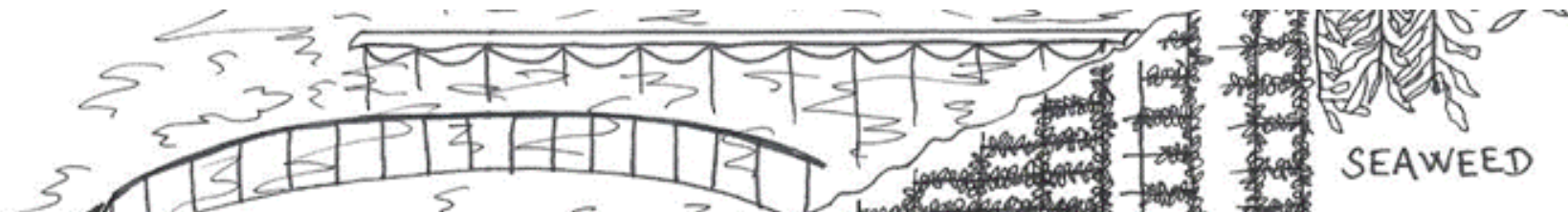
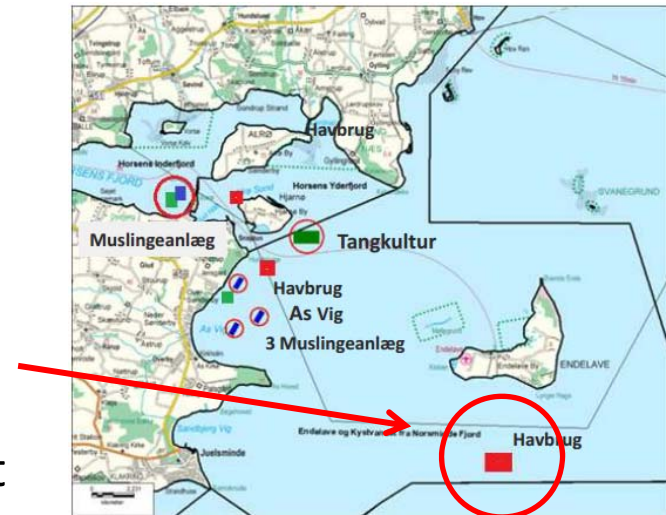




## Scenario/frame for the new facility in 2016:

- (Now only 50 t juvenile equivalent to harvest 200 t fish)
- Fish: 2,200 t/year: 80 t N release
- Seaweed: 700 t WW/year
- (0.5% N = 2.8 t N removal)
- Mussels: 8,000 t WW/year
- (1.3 % N = 104 t N removal)

Biofilter at the 'old' cultivation sites near the coast



# Cast seaweed at the beach

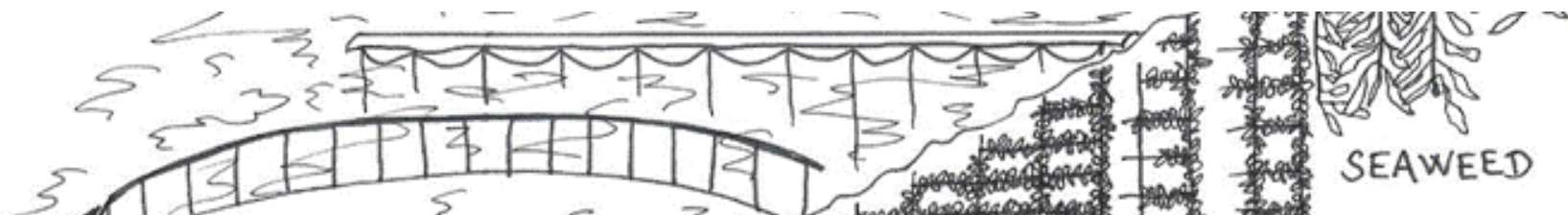
- The Solrød beach example



Eelgrass



*Ectocarpus* and *Pylaiella*



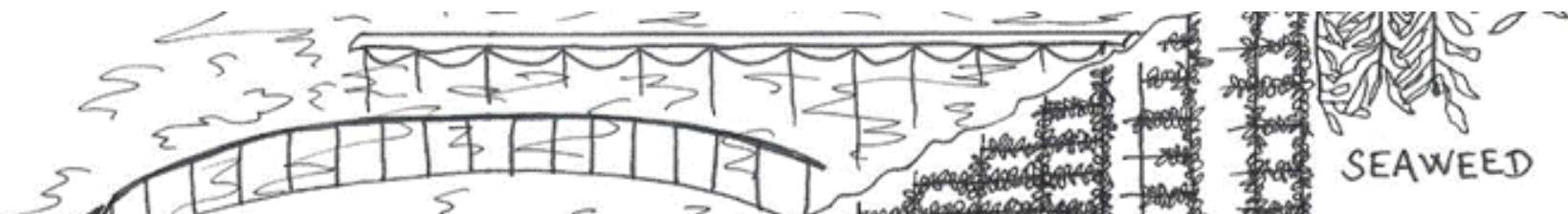
## Cast seaweed harvest

- 20,000 tonnes (incl. sand)/y
- 130,000-190,000 US\$/y
- 6 km coast line in Solrød
- Fertilizer for turfs



## Reducing the N and P

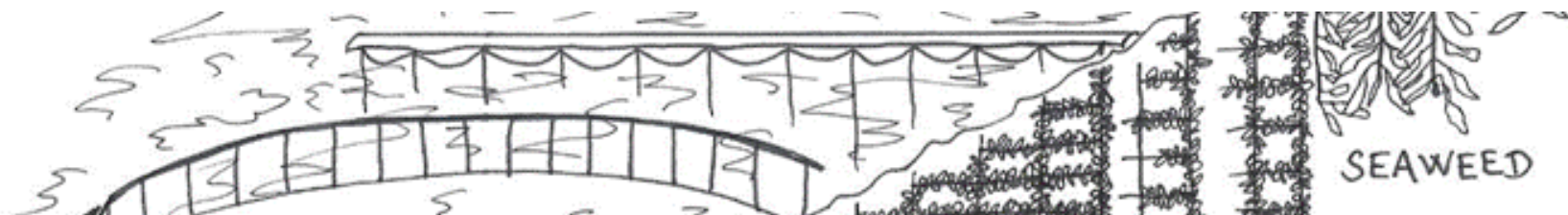
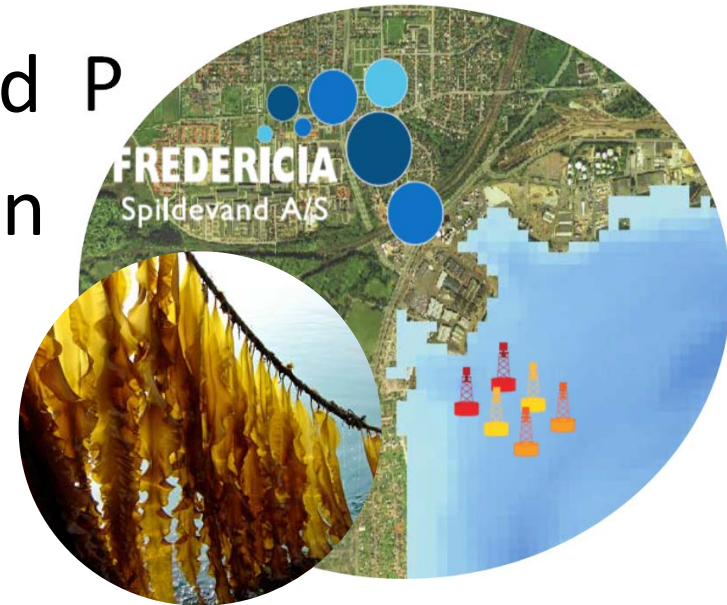
- Not recognized officially by the govt. authorities
- But considered in the region and plans



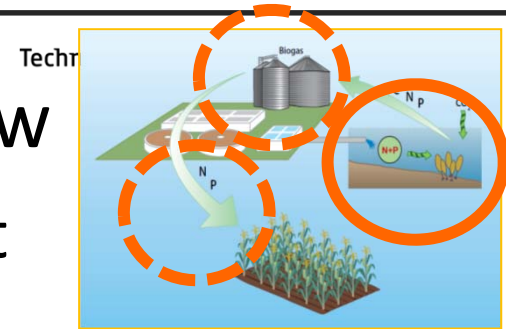
# Seaweed as waste water biofilter (project)

(kindly provided by Annette Bruhn, Aarhus University)

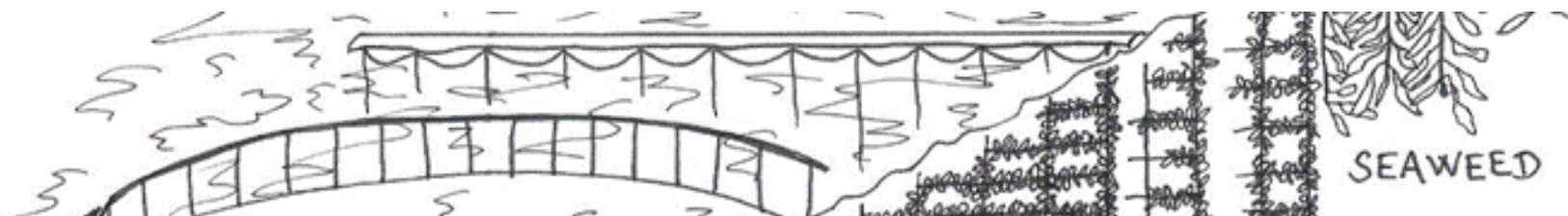
- Municipal waste water
- Demonstrate reuse of N and P
- Include in biogas production
- Evaluation of the sludge
- Economy...



- Seaweed biomass (sugarkelpes) grew
  - Highest N conc closest to WWT plant
- Biogas and sludge
  - Less than 1 ppm so no changes recorded
- Economy perspectives
  - Save 225,000 US\$ if all N removed!



	Release (T / år)	Seaweed (% DW)	Biomass (DW)	Recover (%)	Area (ha)	Fee (US\$/kg)	Fee Saving US\$
N	60	3	<b>2,000</b>	100	<b>400</b>	<b>4</b>	<b>225,000</b>
P	8	0.18	4,444	45		20	75,000
C	190	33	576	347			



## Future perspectives

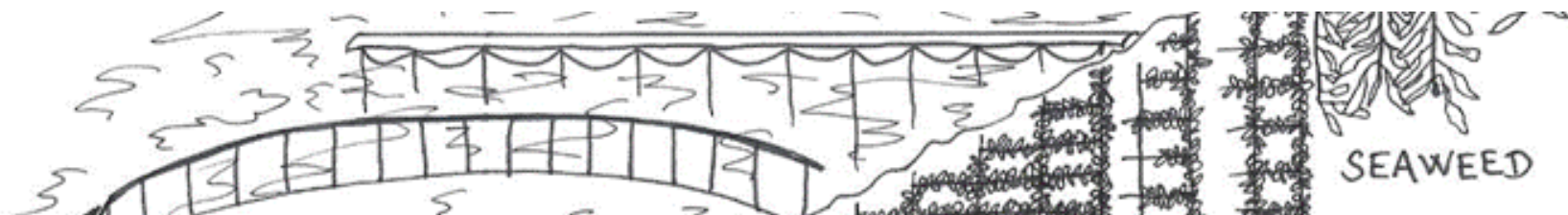
- Seaweed cultivations are recognized as biofilter in Denmark
  - This incl. decoupling
  - However, lower N content than mussel \*
  - Hatchery time \*
  - Mussels are subject to eiders \*
- N-gota: Means that more interest from other fish farmers

(\*Holdt, S.L., Edwards, M.D. (2014) Cost effective IMTA: Comparison between seaweed and mussel biofilter. *Journal of Applied Phycology*, 26, 933-945)



## Future (continued)

- New aquaculture strategy suggest to increase all Danish aquaculture by 50%.
  - New inshore farms must compensate 100% for N and P
  - New large farms are proposed to 'really' move off shore/off coast
- Possible that seaweed (and mussel) will be incl. in BAT
  - More economical feasibility studies are needed
- Cast seaweed biomass removal may be 'real' N-qota in the future
- Extra bioremediation of nutrients by seaweed near WWT plants may be feasible



# Thanks to:

Goncalo S. Marinho (DTU),

Lisbeth J. Plesner (DA) and Annette Bruhn (AU)

GUDP: Project number: 3405-11-0375

## Projektdeltager

- › [Hjarnø Havbrug](#)
- › [Dansk Akvakultur](#)
- › [Orbicon](#)
- › [DTU-Miljø](#)
- › [DHI](#)
- › [TripleNine 999](#)
- › [Seaweed Seed Supply](#)



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