COEXIST - Interaction in European coastal waters: A roadmap to sustainable integration of aquaculture and fisheries, Baltic Case Study

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Pariseapate, Riga, November 1st 2013

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1. COEXIST at a glance

- **Title:** **COEXIST - Interaction in European coastal waters: A roadmap to sustainable integration of aquaculture and fisheries**
- **Programme:** **FP7, Cooperation, Food, Agriculture and Fisheries, and Biotechnology (KBBE)**
- **Instruments:** **Coordination and Support Action (Coordination action)**
- **Total budget:** **€3,777,931**
- **EC contribution:** **€2,995,500**
- **Duration:** **April 2010 – March 2013 (extended until June 2013)**
- **Consortium:** **13 partners from 10 countries**
- **Coordination:** **Institute of Marine Research, Norway**
- **Web:** **www.coexistproject.eu**

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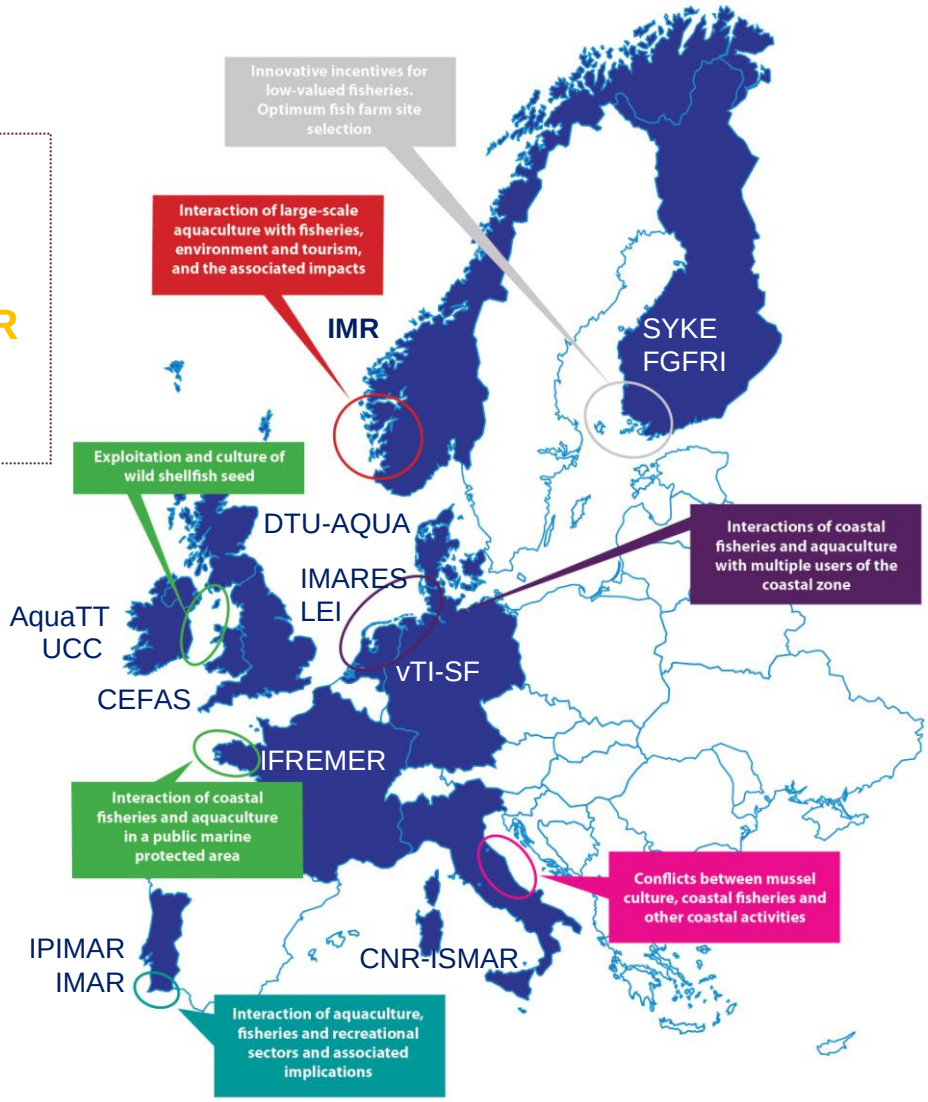
3. Consortium and Case Studies

1. HARDANGERFJORD – LP:IMR
2. ATLANTIC SEA COAST - LP: UCC
3. ALGARVE COAST - LP: IPIMAR
4. ADRIATIC SEA COAST – LP: CNR-ISMAR
5. COASTAL NORTH SEA – LP: TI-SF
6. BALTIC SEA – LP: FGFRI



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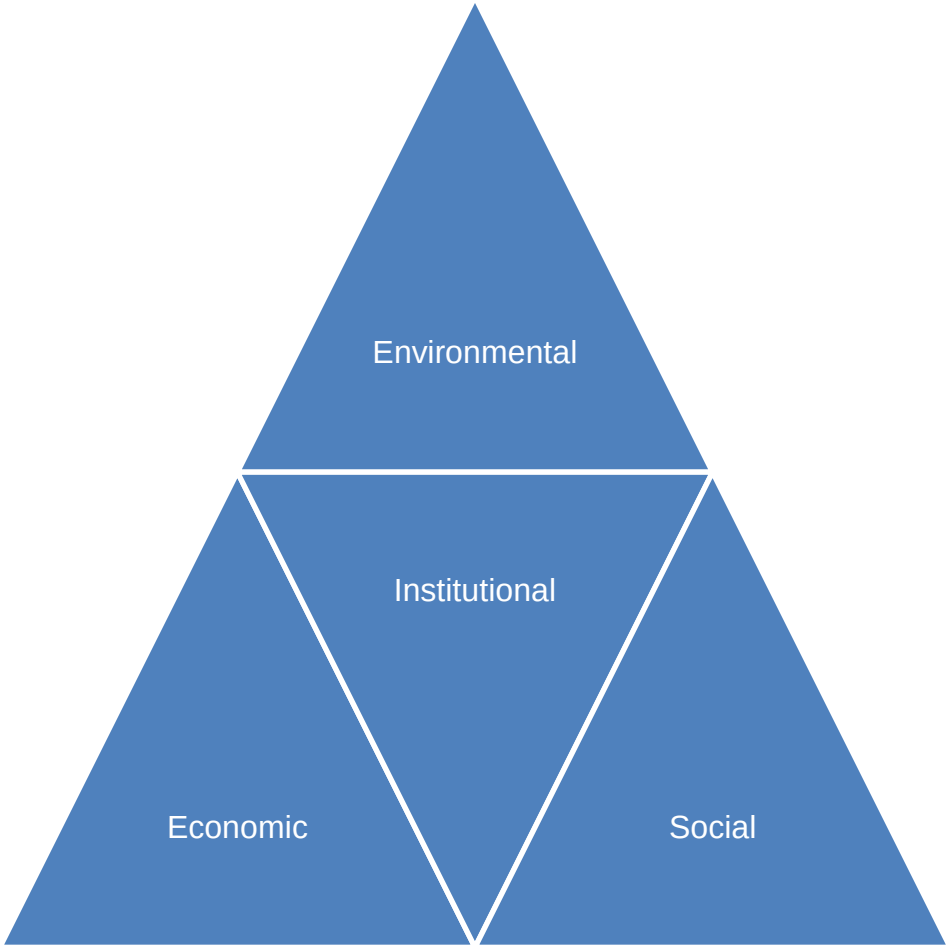
Three aspects of sustainability



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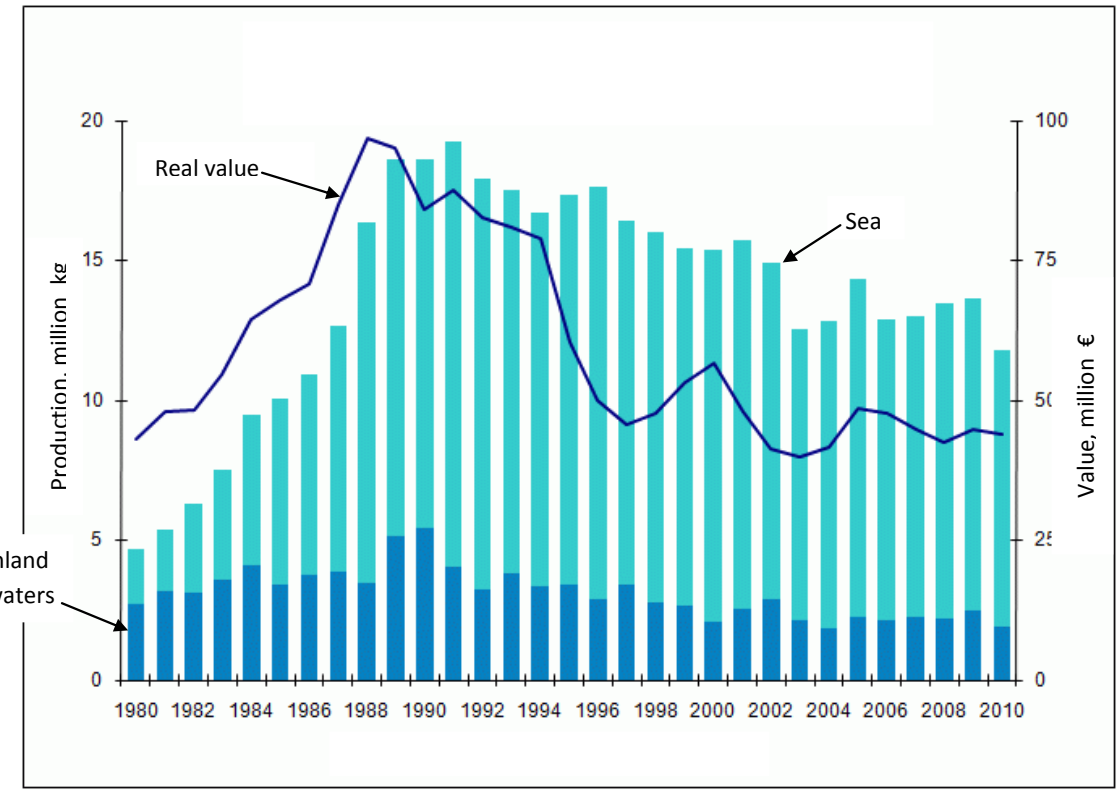
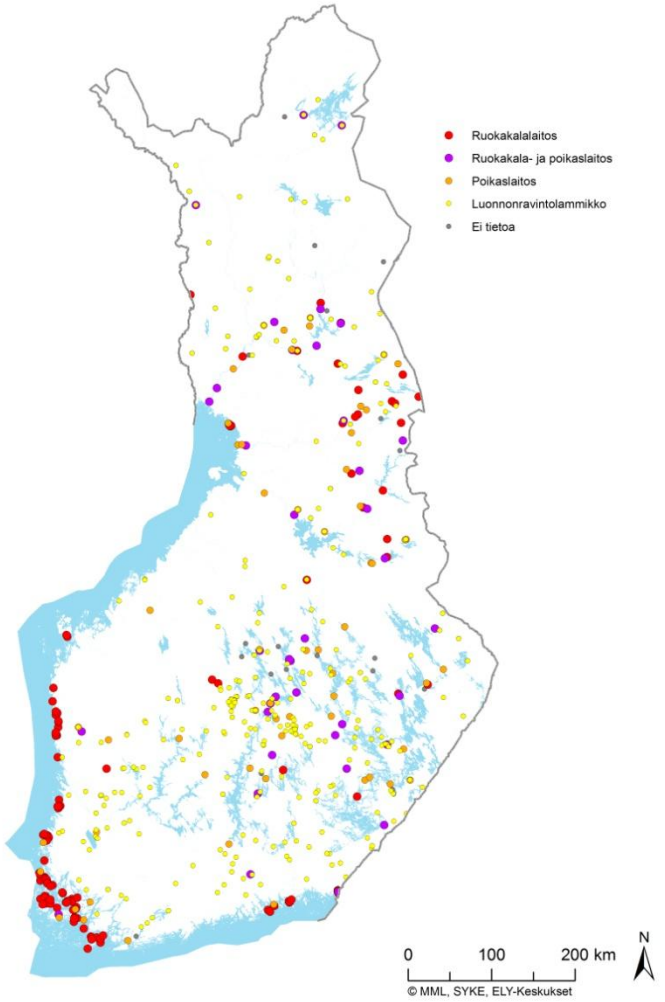
Rainbow trout farmed in Finland





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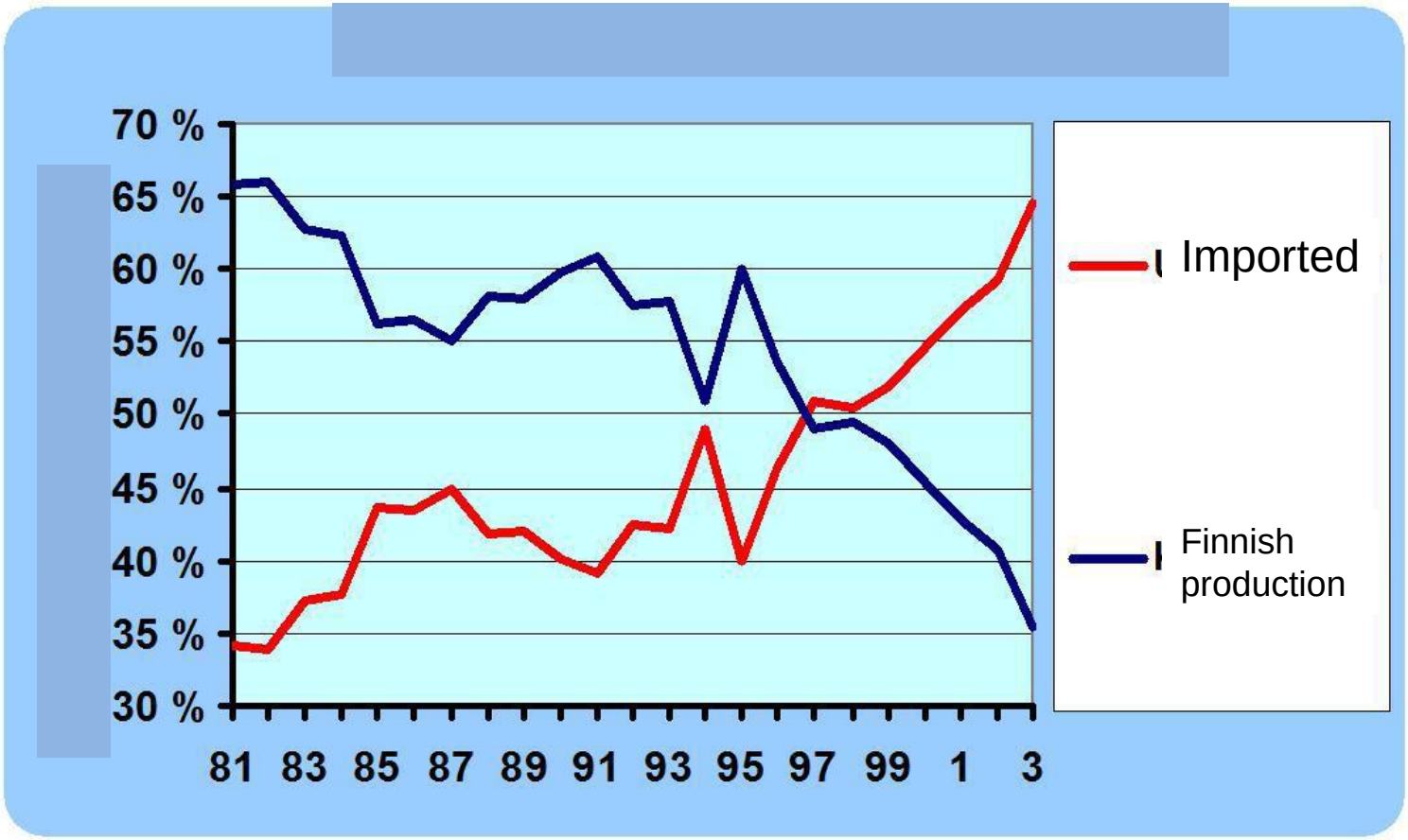
Source: kalankasvatuksen ympäristönsuojeluohje

Market growth by imported salmon



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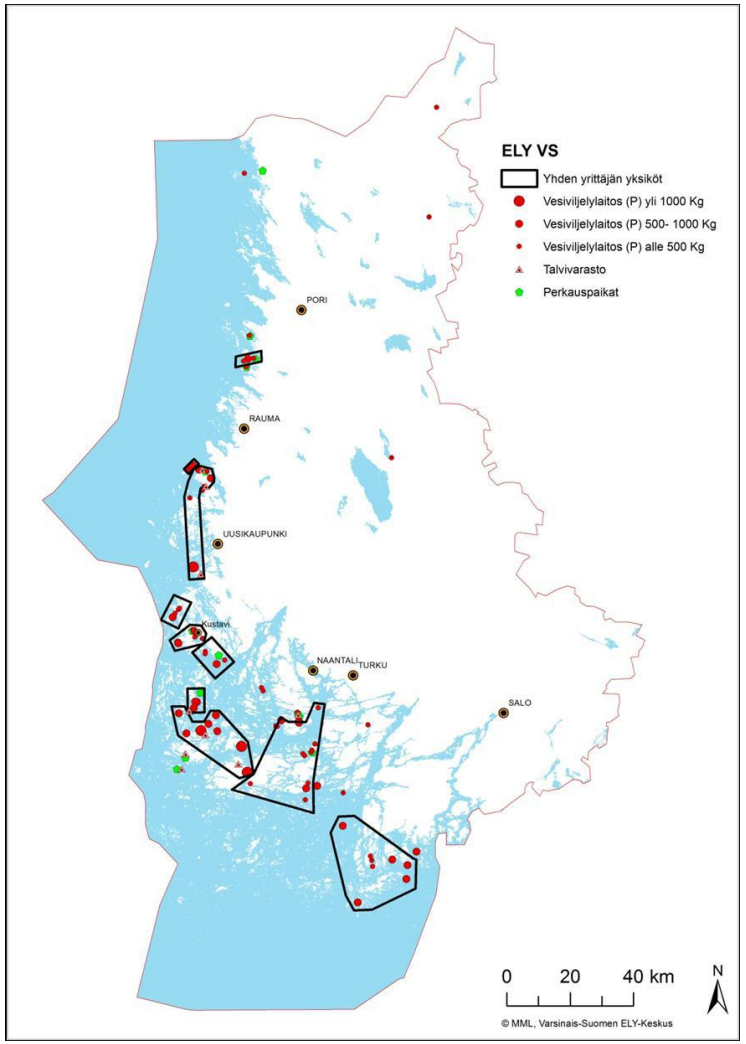
Present structure of the fish farming

Dispersed in small units

A fish farming company has usually many sites



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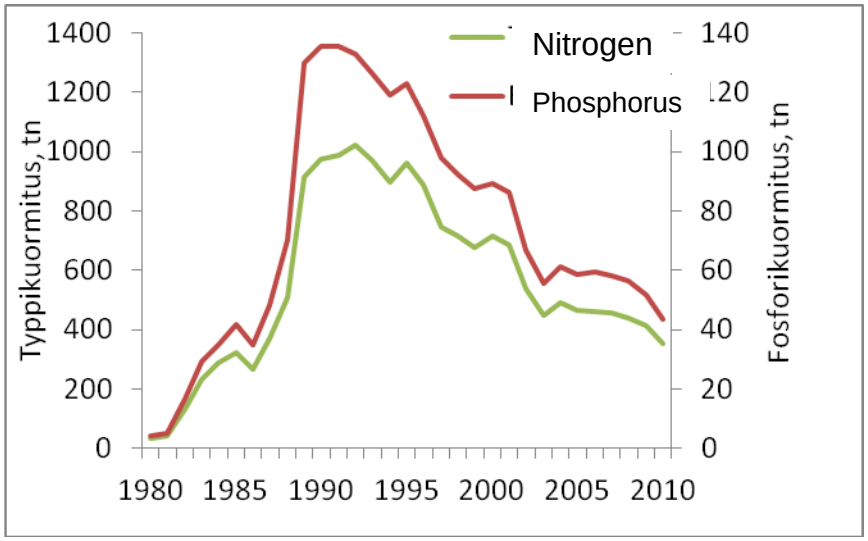
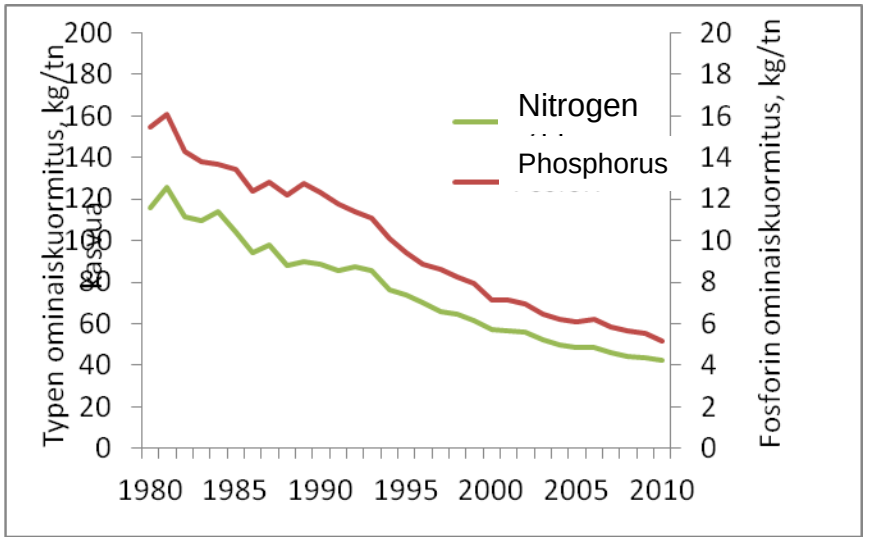
Loading has decreased

Total nitrogen and phosphorus loading



Spesific nitrogen and phosphorus loading



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Source: kalankasvatuksen ympäristönsuojeluohje

Life cycle environmental impacts of different fish farming alternatives in the Baltic Sea

Juha Grönroos[1], Frans Silvenius[2], Markus Kankainen[3], Kimmo Silvo[1], Timo Mäkinen[3]

[1] Finnish Environment Institute SYKE

[2] MTT AgriFood Research Finland

[3] Finnish Game and Fisheries Research Institute FGFRI

SOURCE:
http://info.ices.dk/products/CMdocs/CM-2012/Q/Q0212.pdf

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Materials production

Electricity production

Heat production

Fuels production

Chemicals production

fertilisers

pesticides

antifouling

Fishing

Fish meal and oil production

Soy, wheat, rape seed production

Processing⇨
-Soy meal & concentrate
-Wheat flour
-Rape seed oil

Feed manufacturing

Smolt production

Fish farming

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Environmental indicators

- Climate change (carbon footprint, CO_2-equiv.)
- Eutrophication of the waters (PO_4-equiv.)
- Primary energy consumption (GJ)

Fish farming options

0. **Present situation**

1. **Net loading option** (fisheries of low-valued stocks for nutrient removal to justify aquaculture licenses)

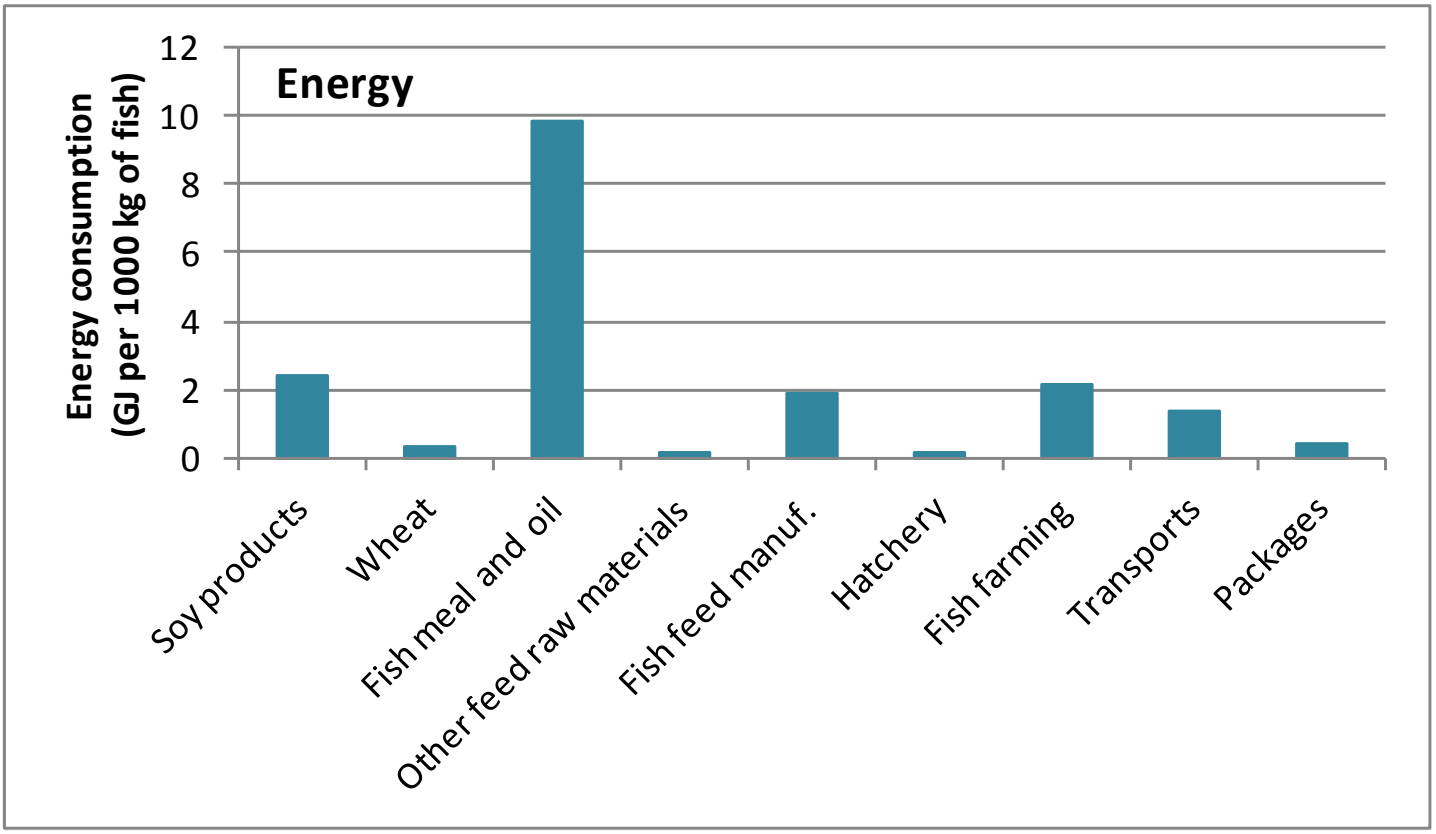
2. **Baltic Sea feed** (nutrient recycling within the Archipelago fisheries and aquaculture)

3. **Rationalized farming site location strategy** (fewer, bigger and better located farms)

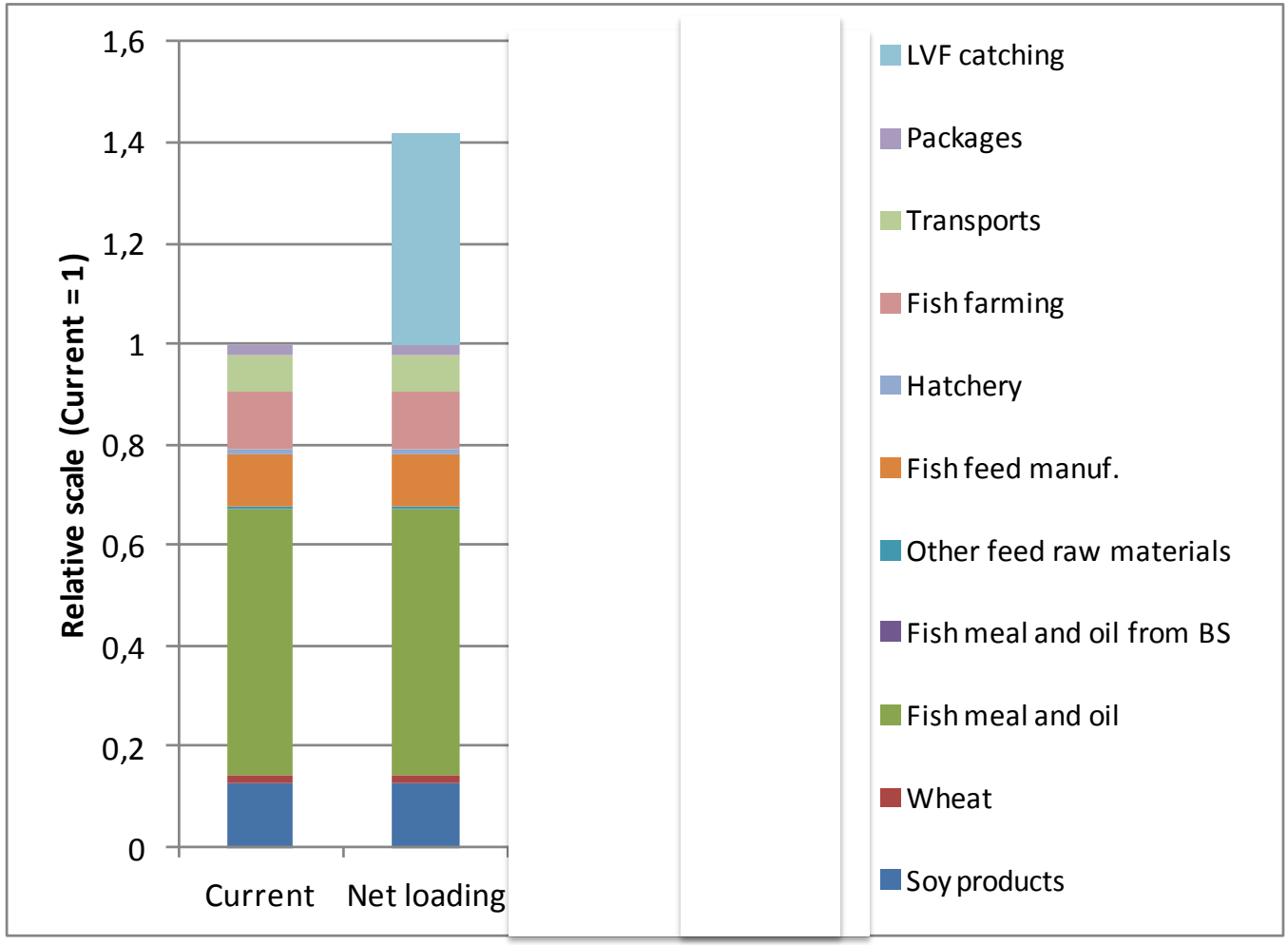
Management options – what differs?

	Net loading	Local feed	Offshore
Fish feed (FF) raw materials production	No changes	Changes in **fishing**	No changes
Feed manufacturing	No changes	**Dioxin removal** from fish must be included to the system. FF **manufacturer** may change	No changes
Transport	Low value fish (LWF) **transport** must be included in the system	Transport distances (and means) of fish **feed raw materials**	Changes in distances and means **between land and fish farm**
Smolt production	No changes	No changes	No changes
Infra (at farm)	No changes	No changes	More **heavier** constructions and boats
Adjoining system (fuels, electr, heat, chemicals)	No changes	If manufacturer of the FF and fish meal and oil changes ⇨Changes in **energy production**	No changes
Other	LWF **fishing** must be included in the system LWF is fed to fur animals (**replaces** other fish caught from the BS)		

Current case: results



Comparison: energy consumption



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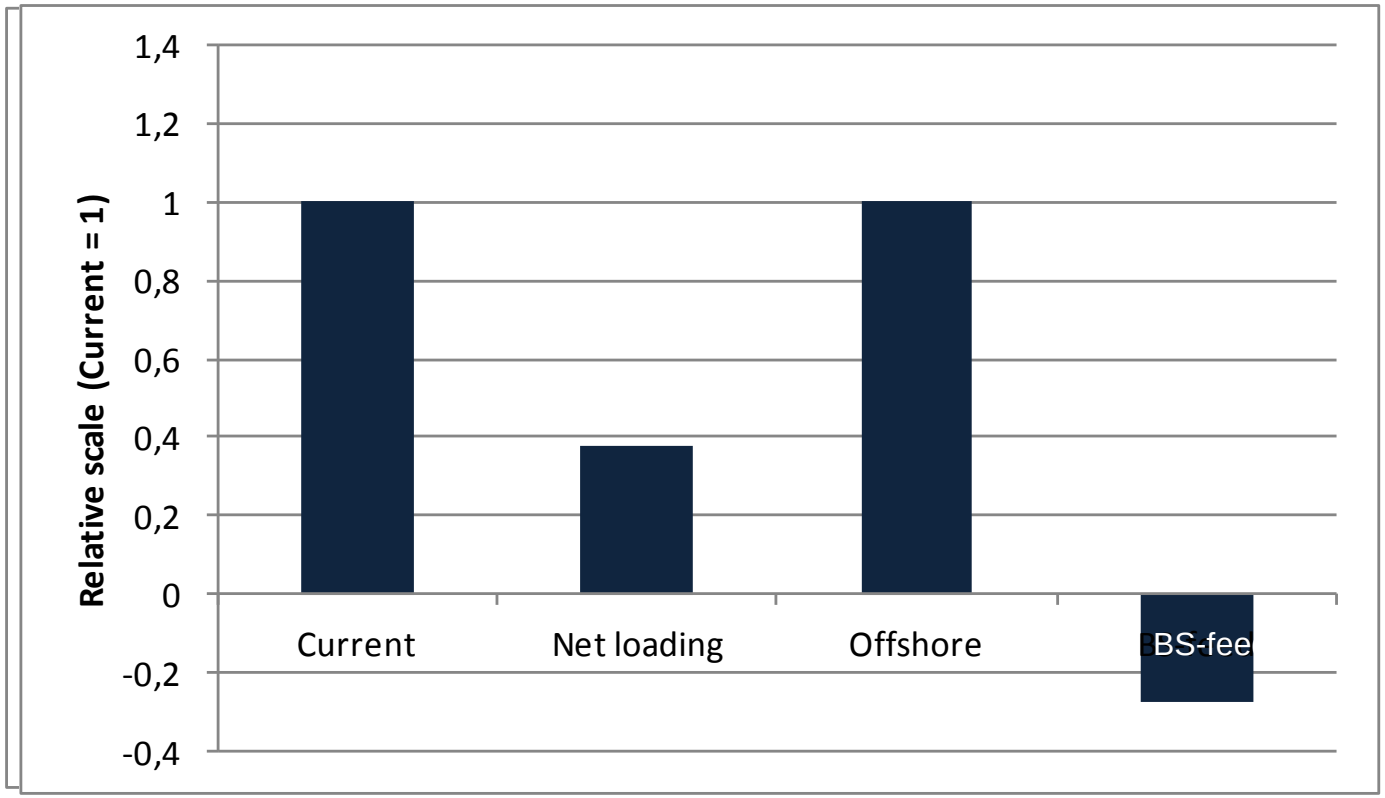
Comparison: climate and eutrophication



Conclusions

- Present system:
  - Decrease nutrient load from fish farming (practically & techically)
  - Use renewable energy and utilize organic wastes maximally
  - Be awake to the environmental impacts of feed raw materials production
- Net loading: present system and…
  - Result is very sensible for the end use of LVF: if not used in BD production but replaces fish used in fur animal feeding ⇨ net effect ≤ 0
  - Minimise fuel consumption of LVF fishing
- Offshore: see present system
- BS feed: see present system, and…
  - Minimise fuel consumption of fishing
  - A new alternative ⇨ composition of the fish feed is not known yet ⇨ may (significantly) affect to the final results

Site selection plan, objectives

- Recognize the areas especially suitable for aquaculture
- Diminish conflicts and nutrient loading in the inner archipelago
- Harmonize economic and environmental policies to make the aquaculture sustainable
- Make the farming more profitable

Sources:

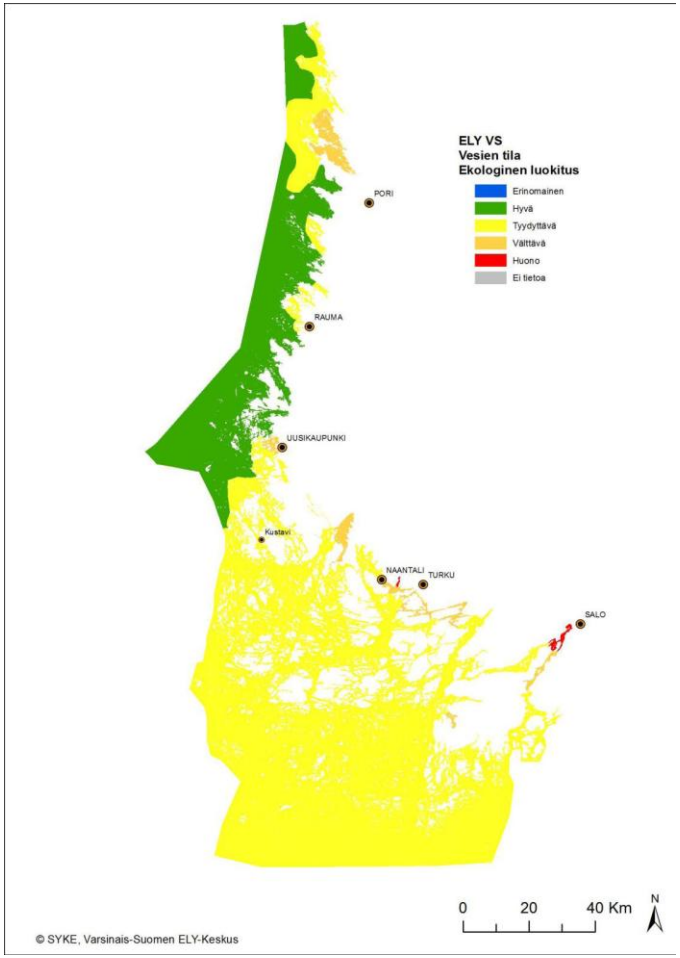
http://info.ices.dk/products/CMdocs/CM-2012/Q/Q0212.pdf

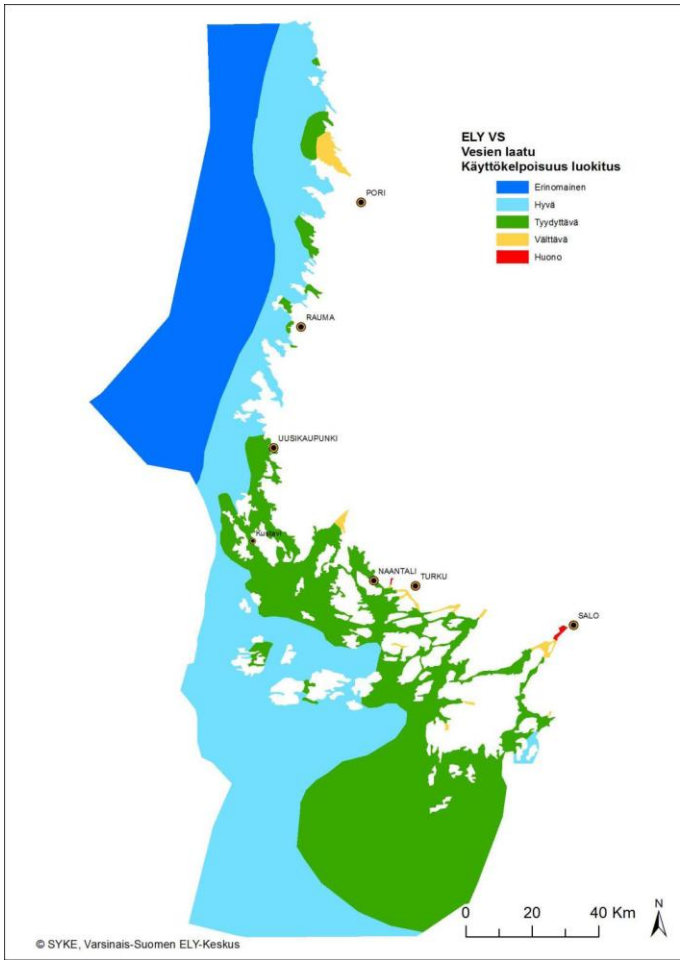
http://www.mmm.fi/attachments/kalariistajaporot/lausuntopyynnot/6E3Tm6zDH/Vesiviljelyn_kansallinen_sijainninohjaussuunnitelma_110113.pdf

Satakunta county as a pilot

- Criteria from a national committee
- A regional planning committee with broad participation
- Expert hearings
- Recognizing the suitable areas with background data using GIS-tools
- Modelling the future production figures
- Environmental impact assessment

Criteria: ecological status and usefullness classification of water areas





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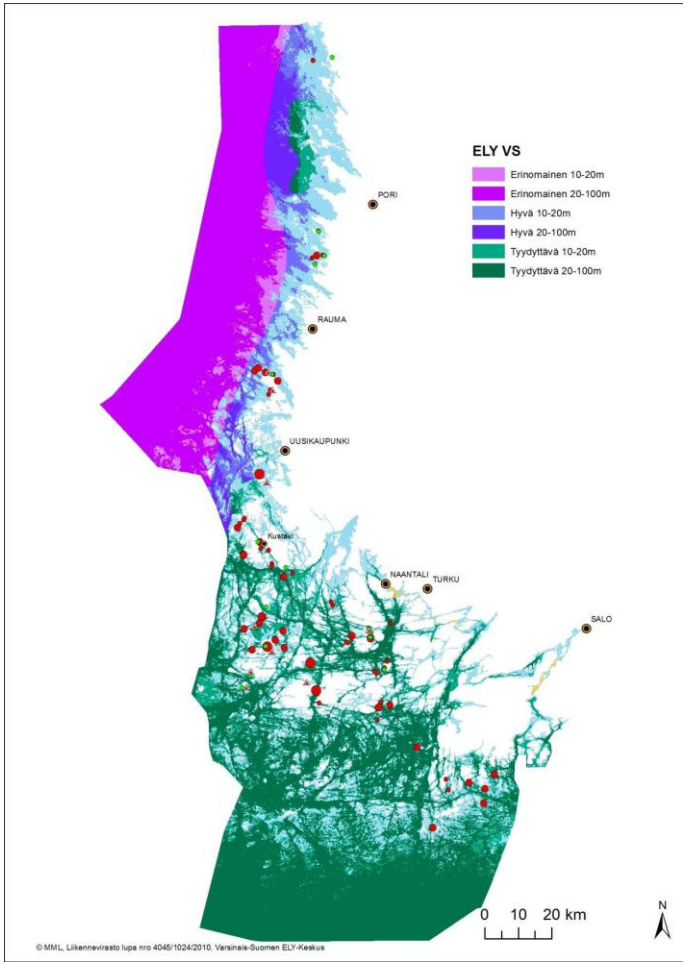
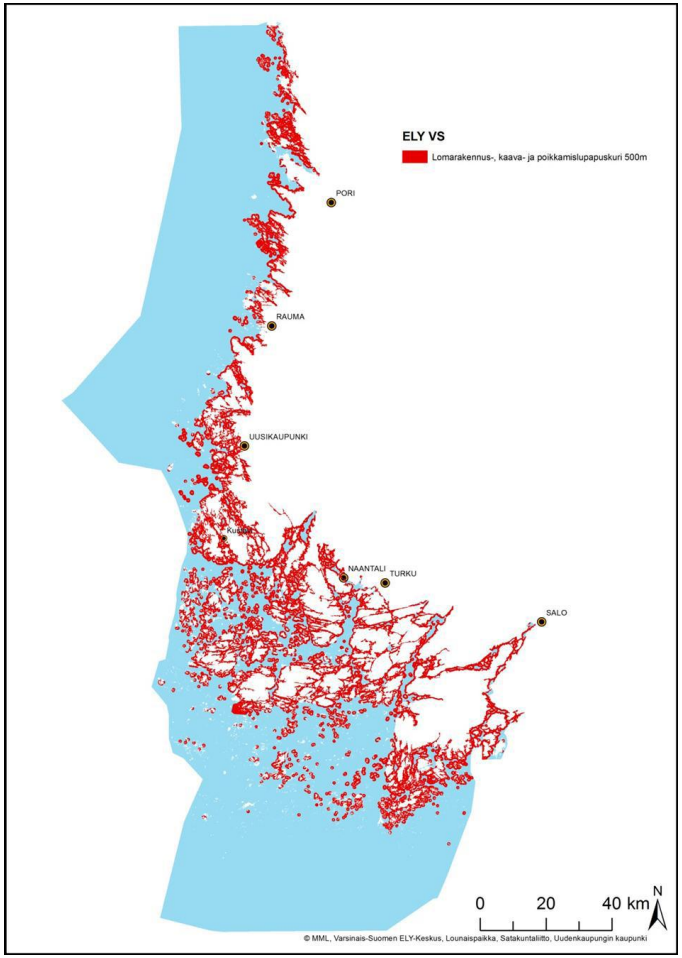
Criteria: Water depth, Summer houses and the recreational use in the regional plan





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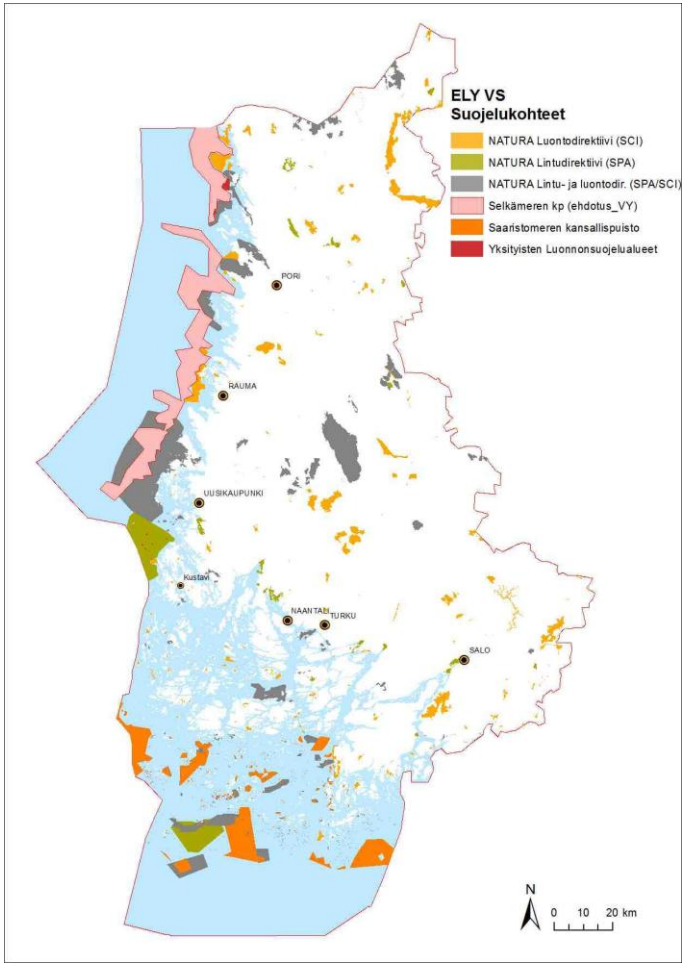
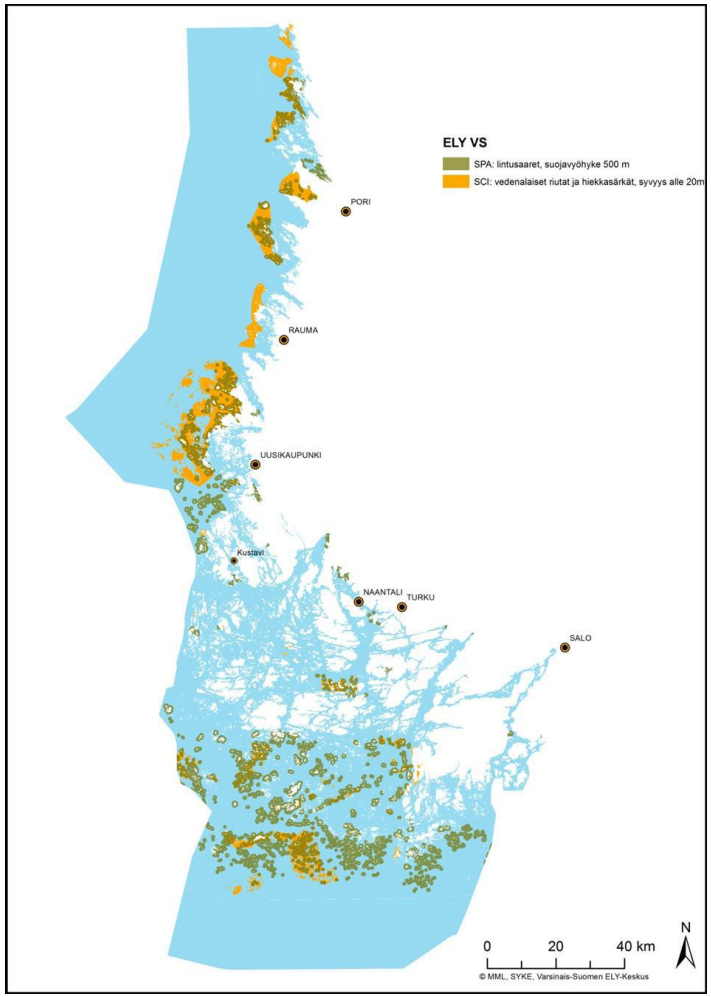
Criteria: Nature protection and Natura areas





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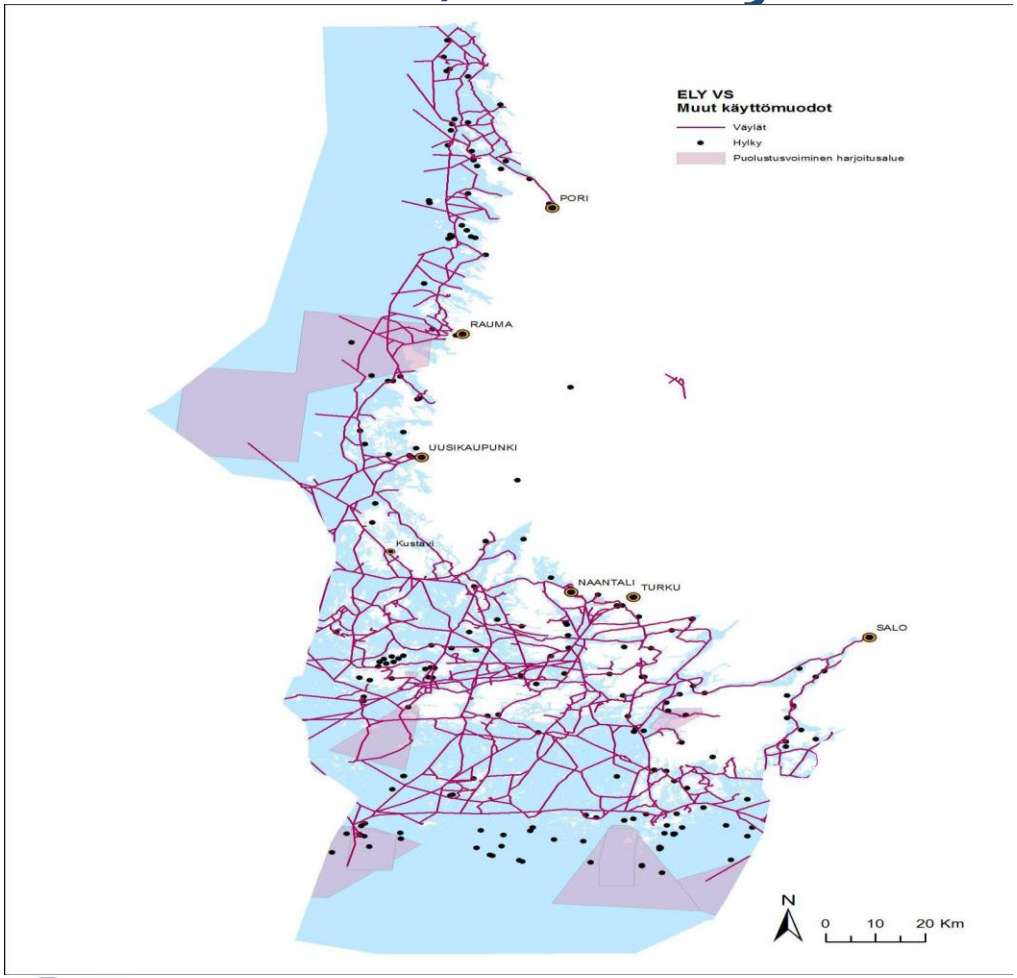
Criteria: other uses, like shipping routes, military use



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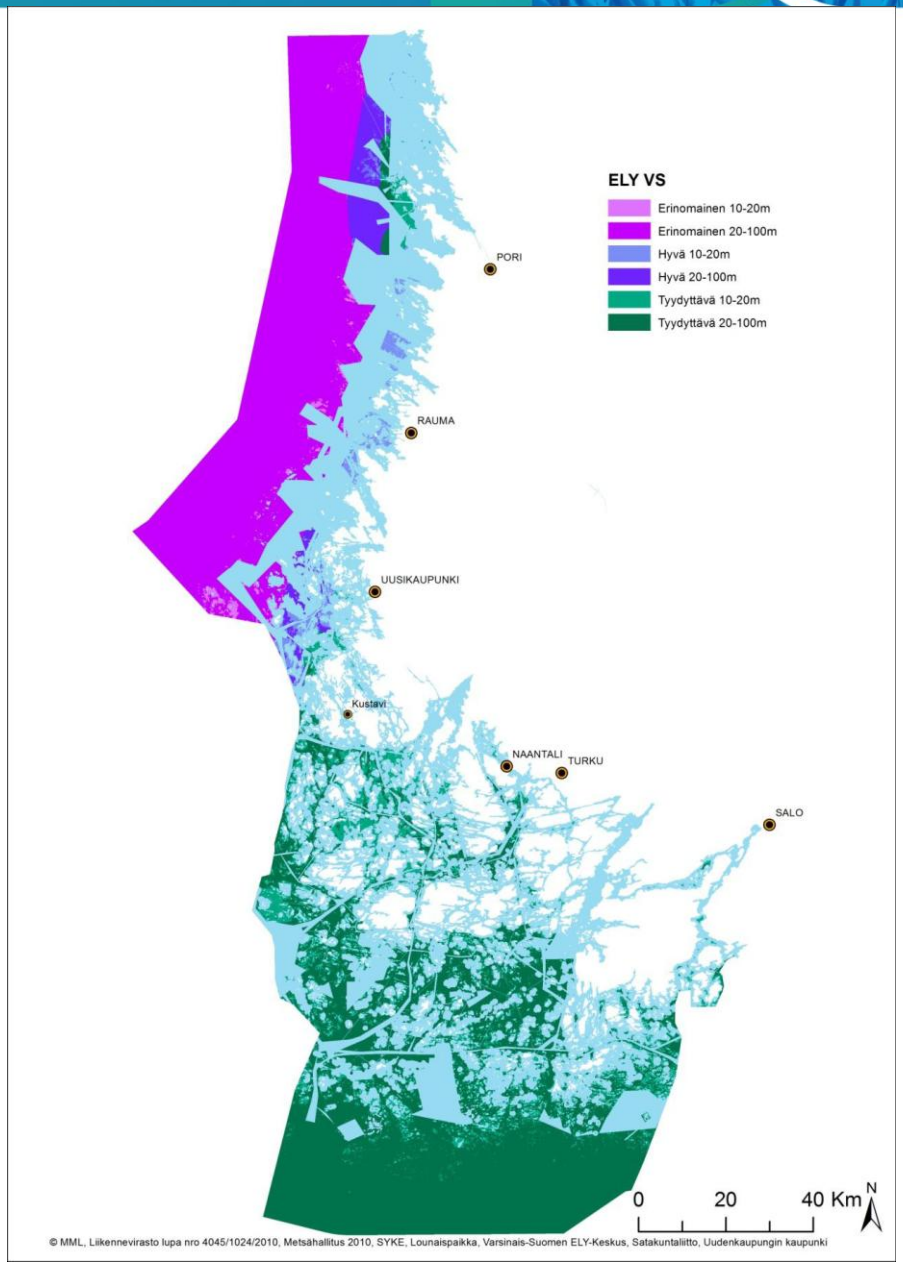
The areas recognized

Archipelago area	Area	Excluded
SW inner archipelago	681 km^2	94 %
SW middle archipelago	1285 km^2	76 %
SW outer archipelago	4217 km^2	53 %
Gulf of Bothnia inner coast	828 km^2	95 %
Gulf of Bothnia outer coast	1543 km^2	72 %
Archipelago and coastal area	554 km^2	67 %



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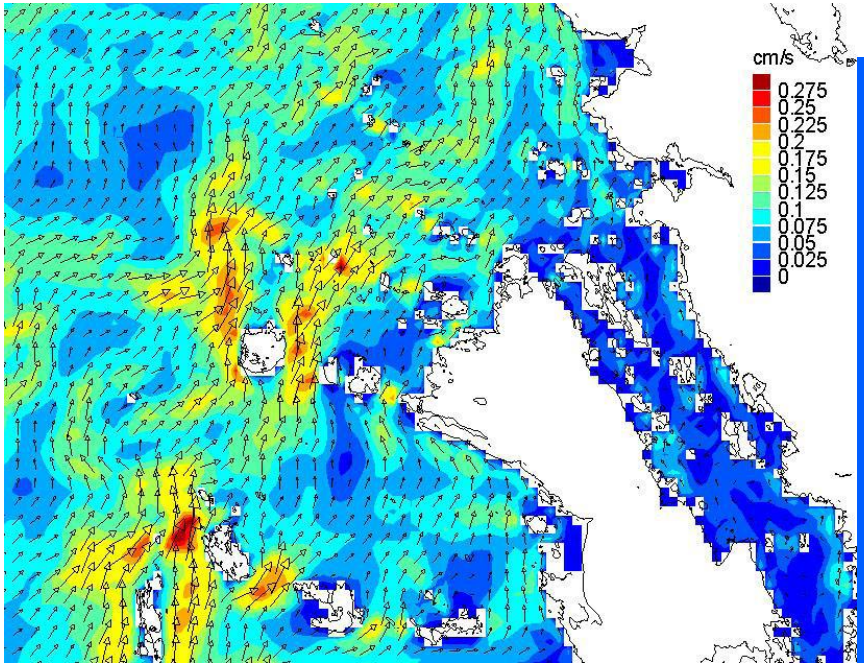
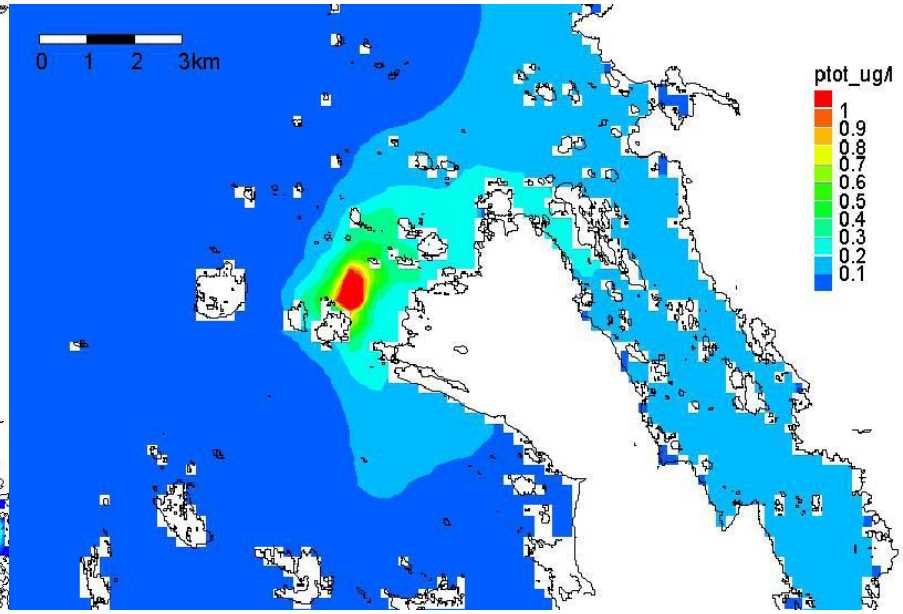
Modelling the nutrient flow



Currents



Nutrient load dispersion

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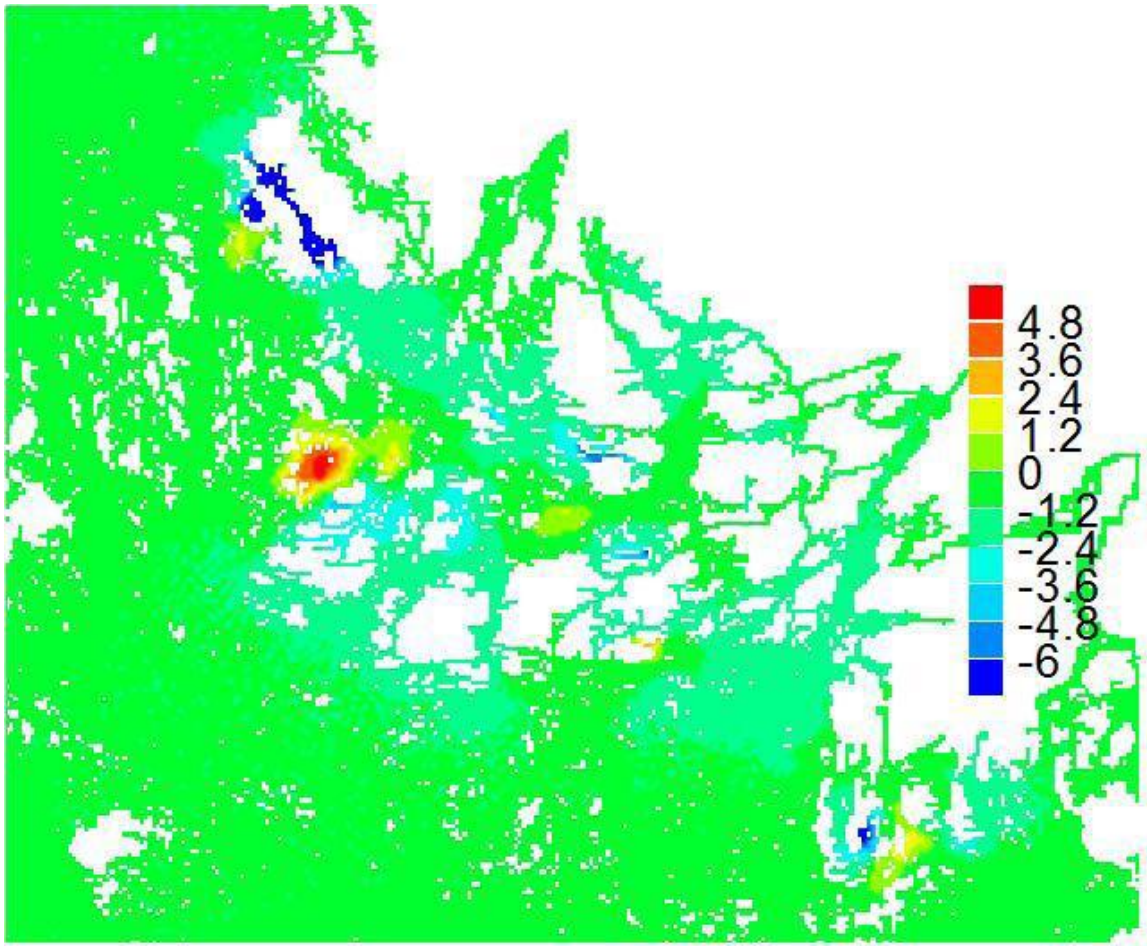
Change in the algae amounts

Changes in the chlorophyll contents (%)



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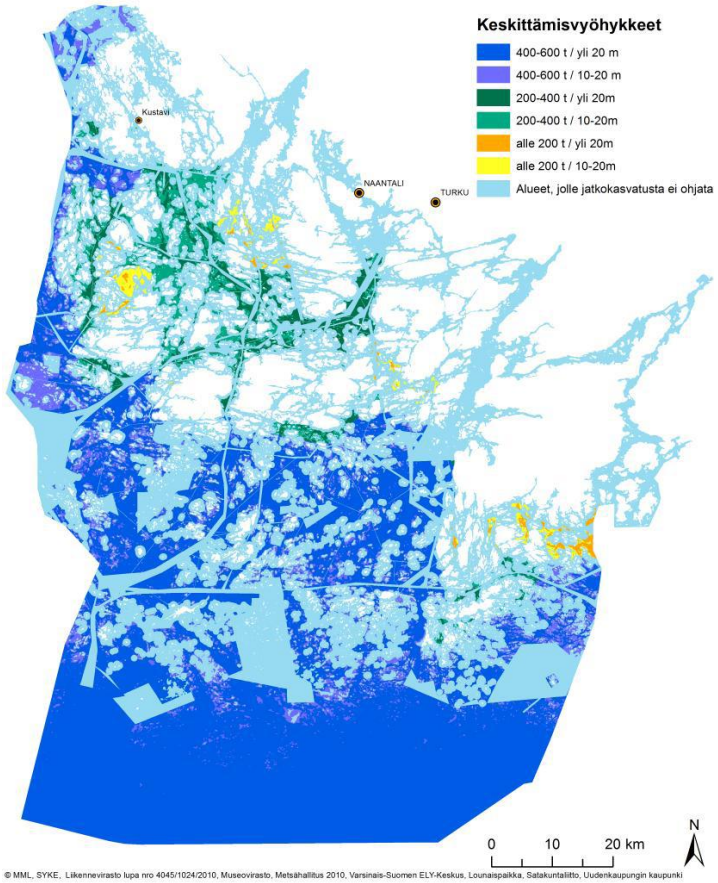
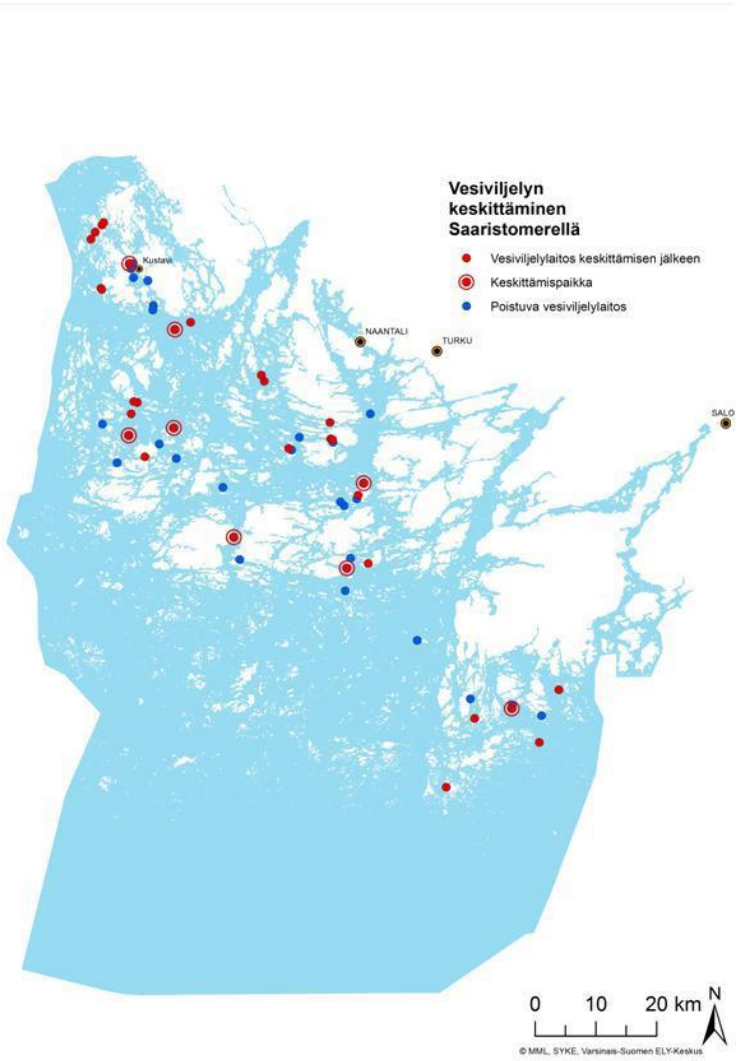
In the archipelago Sea, zones gathering small units together





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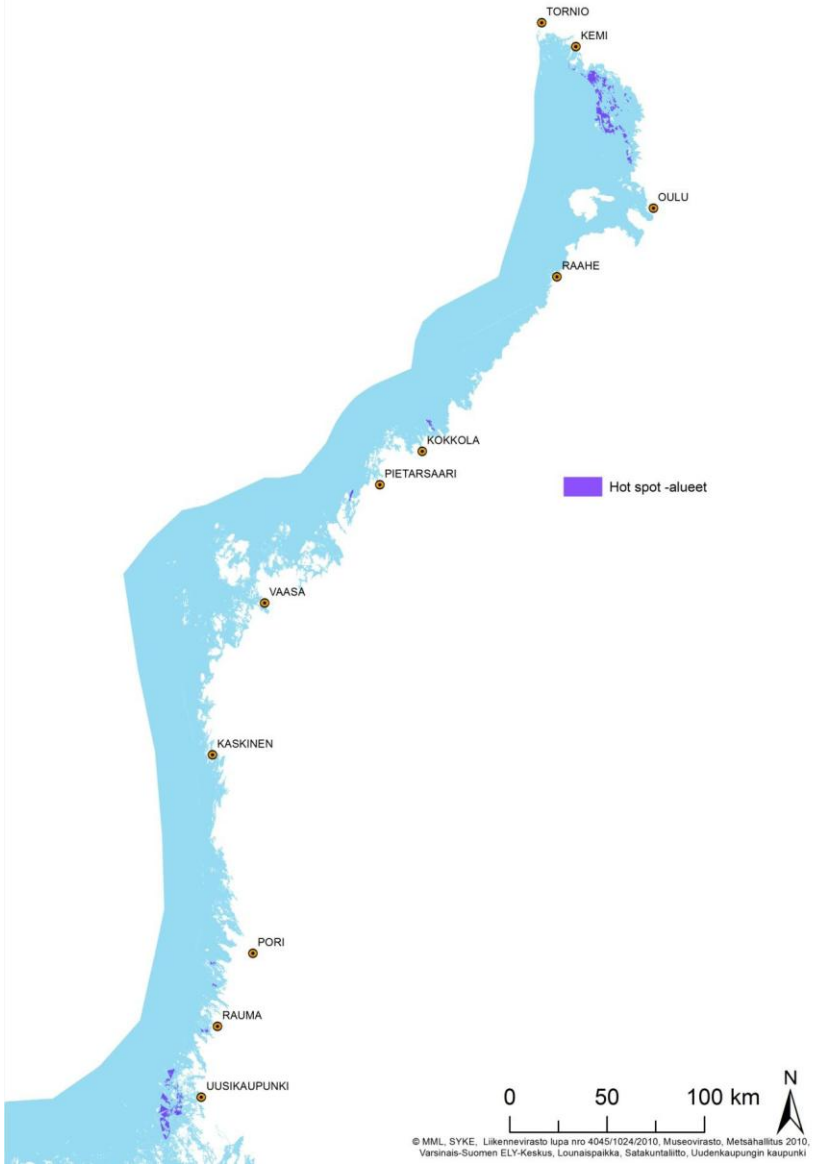
Consequences in the Archipelago Sea according to the plan

- Algae content increase less than 4%
- The number of farming units by the participating companies will be 60% less
- More than 80% less summer houses under 0.5 km distance from the farms

Most promising areas for the future growth

- less sheltered
- offshore farming techniques
- Wind power parks?



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Profitability threshold

A good plan for the farmers?

1. Profitability
2. Concurrence from Norway and Sweden (Estonia)
3. Heavy burden of permit bureaucracy

Towards interactive fish farming governance? a comparison of Finland and Sweden

Mäkinen Timo, Salmi Pekka & Forsman Leena

Aquacult Int DOI 10.1007/s10499-013-9700-3

Finnish Game and Fisheries Research Institute

Fish farming governance goals in the Baltic Sea area

Decreasing adverse ecological effects;

Optimization of the use of coastal areas at regional, nation-wide and the Baltic Sea level;

Creating and maintaining firm jobs opportunities to private fish farmers in the rural archipelago areas;

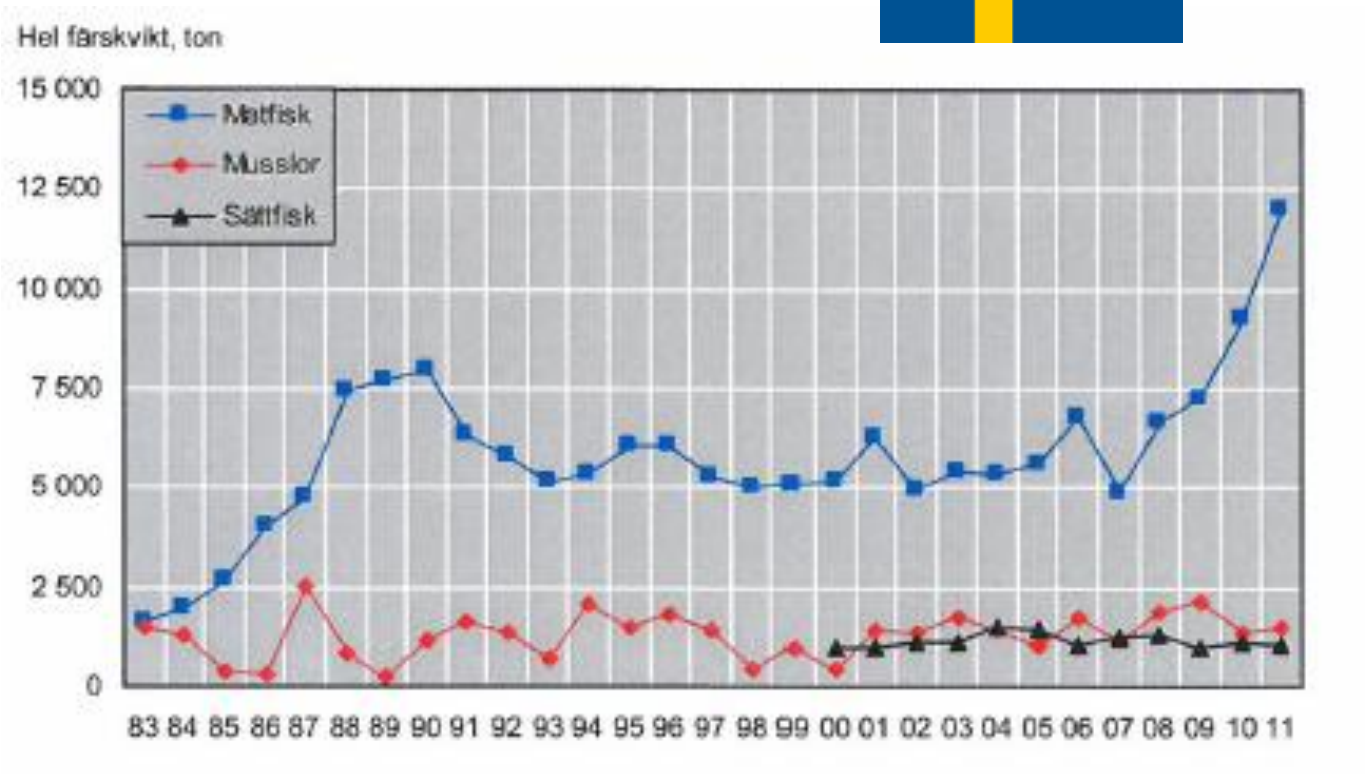
Supporting regional fisheries and economic development

Production 2011

	Sweden	Finland
Production (million kg)	12.0	11.3
Value of production, (million €)	36.8	47.1
Share of rainbow trout of the production	89.8 % The rest mainly arctic char	87.6 % The rest mainly whitefish
Number of farms (food fish)	79	178
of which in the Baltic Sea coast	18 (only rainbow trout)	111
Farms producing more than 100 tons/a	15 Producing 95 % of the Swedish production	only few

(Statistics Sweden (SCB), Statistics Finland (SVT))

Swedish Production 1983-2011



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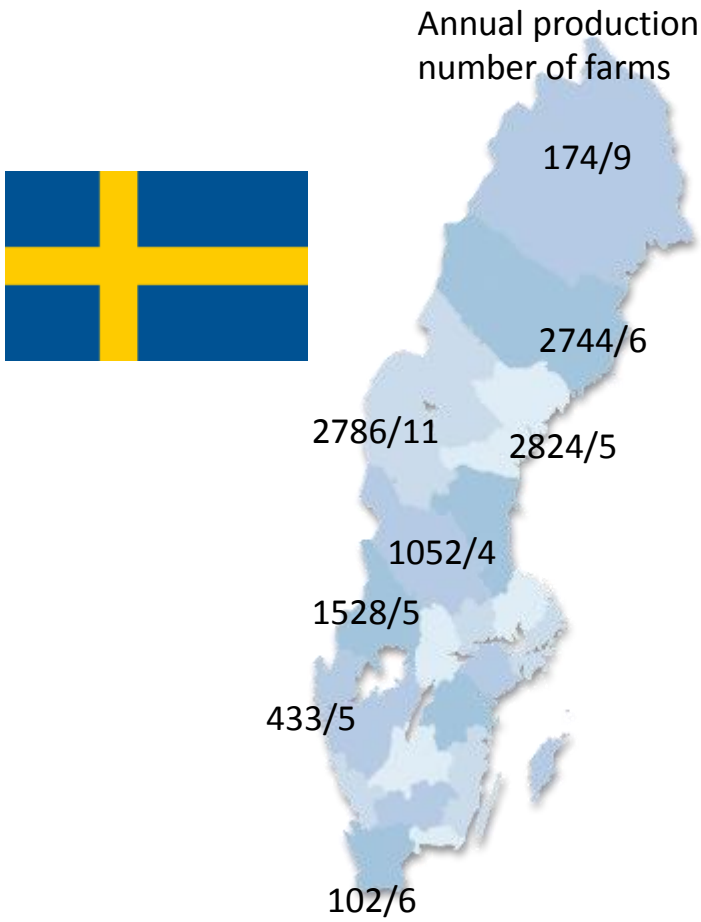
Swedish production and number of farms in 2011



Counties with production >100 tons:
Norrbotten
Västerbotten
Västernorrland
Jämtland
Dalarna
Värmland
Västrä Götaland
Skåne

Statistics Sweden (SCB)

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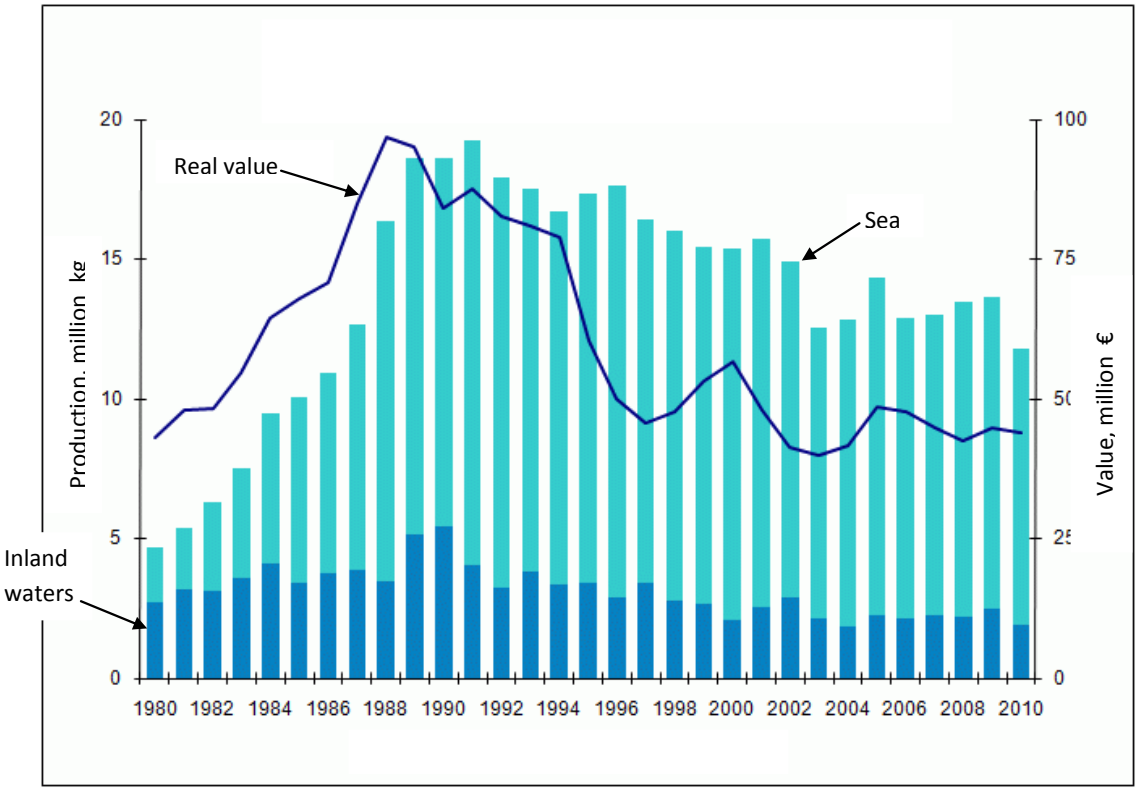
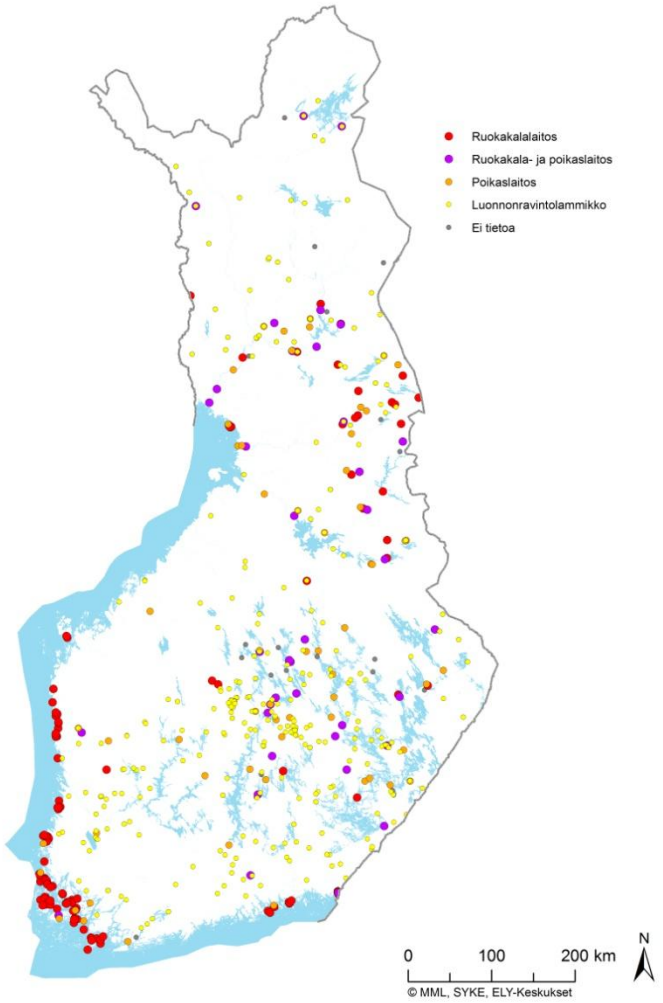
Finnish production 1980-2010 (tons/a) and number of farms in 2010





Source: Kalankasvatuksen ympäristönsuojeluohje

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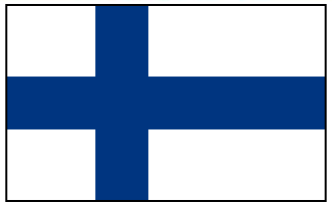
A permit needed when,



Sweden

- When use of dry feed exceeds 40 tons/a, a permit from regional county is needed. If it is between 1,5-40 tons/a, a notification to the local municipality serves (the environmental legislation)
- According to the Fishery Act all aquaculture needs a permit from the regional county

Finland

- When production (=plusgrowth) exceeds 2 tons/a or use of dry feed 2 tons/a
- Or if the size of a pond culture is at least 20 ha

Legislation

- Very similar in both countries
- Permit is required according to water and environment legislation in Finland and fisheries and environmental legislation in Sweden
- One application is adequate in both countries
- Rearing conditions has to be accepted according to animal protection act in Sweden

Swedish application system

Consultations	•County Administrative Board •Regulatory authority (municipality) •Individuals speciallay affected by the project
Environmental impact?	•County Administrative Board makes a decision whether an application can be prepared and sent forward
Broader Consultations	•County Administrative Board •Supervisory/regulatory authorities •Individuals specially affected by the project •Other state authorities, municipalities, organizations, groups affected by the project
Application with MKB	•Application •MKB (Environmental Impact Description) including report of consultations •Information to the general public
Decision	•County Administrative Board decides if MKB is valid •County Administrative Board accepts the application

Sweden according to Jens Andersson

Finnish application system

Application	• Regional State Administrative Agencies
Possible supplements and consultations	•Regional State Administrative Agencies •Centre for Economic Development, Transport and the Environment management (ELY-center) •Information to general public
Comments	•Regulatory authority (ELY-center, 2 departments) •Municipality •Individuals speciallay affected by the project
Possible consultations	•Regulatory authority (ELY-center) •Regional State Administrative Agencies
Decision	•Regional State Administrative Agencies

Swedish system / Finnish system

Actors:

no differences, more or less the same actors

Institutions:

the role of the local level (municipality) is much stronger in Sweden

Governance:

Sweden: more interaction, collaboration and public-private partnership

Finland: more hierarchical governance, less communication

Principles/main focus:

Sweden: local society and environment

Finland:effluent loads of nitrogen and phosphorus

Monitoring

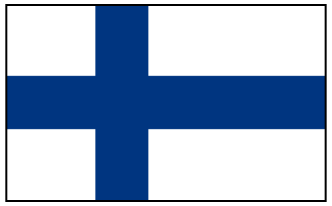
Sweden

Counties often delegate monitoring to the municipalities

Mainly similar as in Finland:

- Annual and loading reports prepared by farmers
- inspector's visits depending on the case (may in some cases be several times a year)

Finland



The Centre for Economic Development, Transport and the Environment is monitoring

Annual and loading reports prepared by farmers

Inspector visits every second year

The Swedish governance practice*:

- Large farms in Sweden (over 1000 tons) in the lake area,
- In the sea area the capacity of the farms owned by Finns are 400-600 tons
- Farm sites are excellent, oligotrophic areas, depth 40-60m, no registered complains although the farms are located near shores
- More difficult to get permits for sea than for lake areas,
  - for sea areas permits are usually for 10-15 years,
- -for lake areas permits are for an indefinite time
- Spatial plan is generally not yet in use in Sweden as it is going to be in Finland in 2013

*interview of a Chief executive of a Fish farming enterprise in Åland islands

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The differences between the two countries*:

"Swedish permit application system is heavy and lasts long (at least half a year) Environmental Impact Description (MKB) laborious." The process is easier in Åland county in Finland.

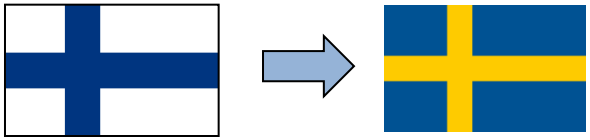
"The real power in Sweden is with the MPD (Environment Advisory Board of County Administrative Board)

Structural policy in Sweden is less supportive (less national funding) and meticulous bureaucracy after the support has been granted

The biggest difference between the two countries is in markets and marketing: there is no big rainbow trout market in Sweden"

*interview of a chief executive of a Fish farming enterprise in Åland islands

Finnish farmers going ”to exile” into Sweden*



Over 5 million kg annually ”Finnish” production in Sweden

Big farms, big plans:

”We have now a million kg farm but it is planned to produce 4 million kgs on that farm in the near future. This plan is prepared in understanding with the local environmental authorities and with their consultative help.”

The Production exported to Finland

”There is no market for big rainbow trout in Sweden”

Sometimes the fish goes first to Estonia to be processed before exportation to Finland

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*The chief executive of a Finnish fish farming company

Are the governance goals in the Baltic Sea area in balance between the regions?

Decreasing adverse ecological effects;

Optimization of the use of coastal areas regionally, nation wide and at the Baltic Sea level;

Creating and maintaining firm jobs opportunities to private fish farmers in the rural archipelago areas;

Supporting regional fisheries and economic development

Economy of alternative production methods

1. ***Micro economy***

- Standpoint: profitability of fish farm enterprises
- Production costs < market price
- Amortizing the investments = economic sustainability

2. ***Macro economy, national economy***

- Profitability makes production figures to increase
- Competitiveness starts the investments
- Investments, jobs, profits = value added = gnp = taxes = Well fare services
- Production amount * price of the product = Value of the production
- Availability of a reasonable priced healthy food stuff

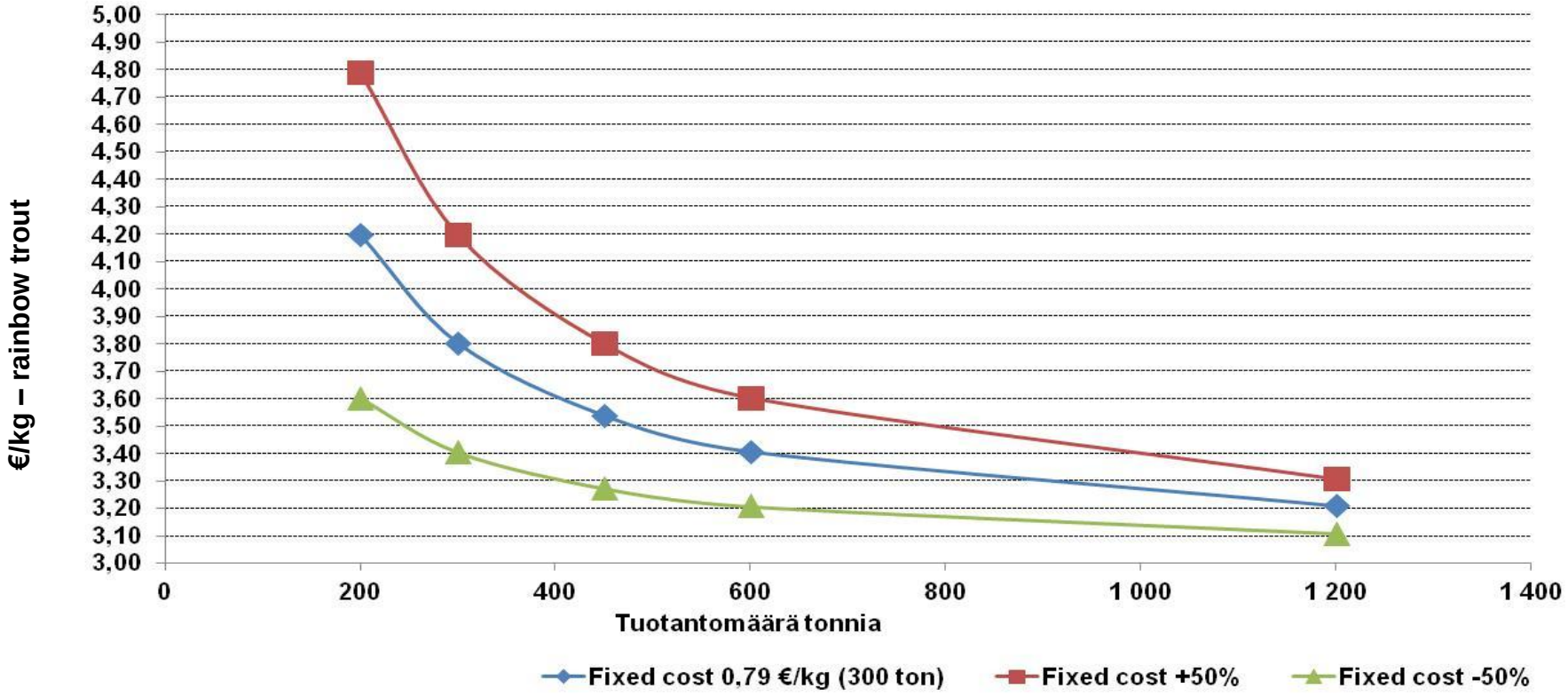
3. ***Regional economy - Coexist case Study the Archipelago Sea***

- Creating jobs for the rural area
- Indirect impacts: maintaining the services
- Indirect impacts: 2 * Value of the production

Baltic Sea Feed

Benefit – incresed production amount

- ***Incentive (National Aquaculture Programme)=> 1,5 * permit => 300 tons farm => production costs decrease 0,26 €/kg => benefit 0,22 €/kg***



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Nutrient compensation by low value fish removal

1. ***Increased costs***

- ***Payment to fisherman about 0,58 €/kg***
- ***Reduce the value of the fish as fur animal feed raw material 0,20 €/kg***
- ***Remainder 0,38€/kg * 1,1 = cost of one kg increased production (National Aquaculture Programme) = 0,42 €/kg***

2. Benefit

- ***Increased production decreases share of fixed cost, see the graph before***
- ***If the farm produces 300 tons and fixed costs are about 0,79 €/kg, a 150 tons increase in production decrease the production cost to 0,52 €/kg, thus, the benefit is 0,10 €/kg***
- ***Profitable if the fixed costs are at least 0,41 €/kg***
- ***Or if the market price of the fish is high***

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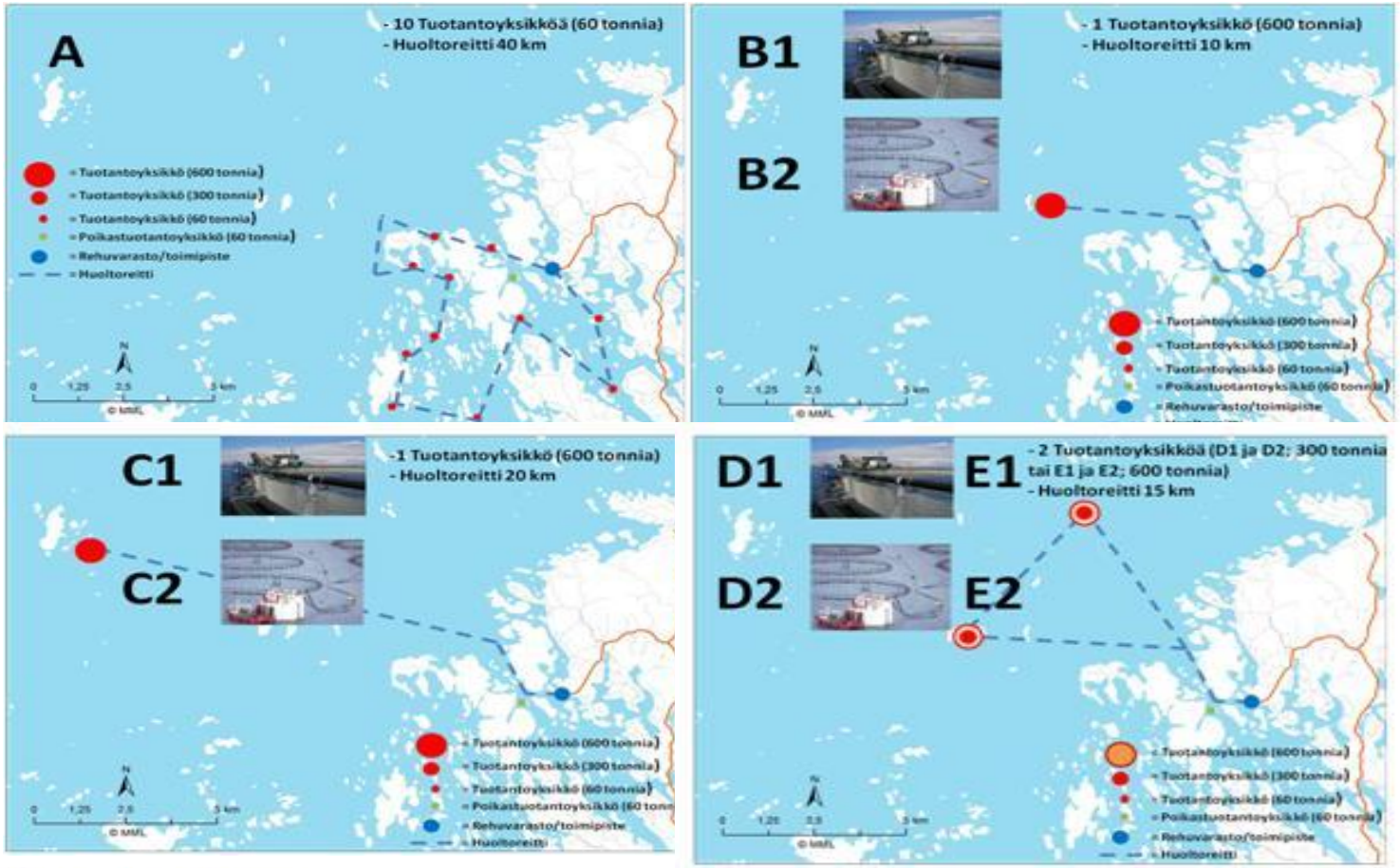
Spatial planning: site selection

Background: more open areas with better water exchange allow bigger units



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Economic impacts: site selection

Osxt and benefit

Theoretically profitability will increase about 0,10 -0,15 €/kg

- **In practice 0,14-0,47 €/kg (Many units merged + labor effectiveness * 2)**

	BAU	Near		Far		2 units		2 * production	
Production option	**A**	**B1**	**B2**	**C1**	**C2**	**D1**	**D2**	**E1**	**E2**
	€/kg	€/kg	€/kg	€/kg	€/kg	€/kg	€/kg	€/kg	€/kg
Personel costs	***0,058***	***0,027***	***0,007***	***0,034***	***0,011***	***0,033***	***0,011***	***0,032***	***0,010***
Cage and fish transfer	*0,013*	*0,003*	*0,003*	*0,006*	*0,006*	*0,005*	*0,005*	*0,005*	*0,005*
Feeding/ observation	*0,045*	*0,024*	*0,003*	*0,028*	*0,004*	*0,029*	*0,006*	*0,027*	*0,005*
Fuel costs	***0,042***	***0,011***	***0,005***	***0,021***	***0,009***	***0,016***	***0,007***	***0,016***	***0,007***
Cage and fish transfer	*0,012*	*0,003*	*0,003*	*0,006*	*0,006*	*0,005*	*0,005*	*0,005*	*0,005*
Feeding/ observation	*0,030*	*0,008*	*0,002*	*0,015*	*0,003*	*0,011*	*0,002*	*0,011*	*0,002*
Investments	***0,598***	***0,527***	***0,590***	***0,527***	***0,590***	***0,527***	***0,655***	***0,482***	***0,547***
Boats	*0,086*	*0,086*	*0,086*	*0,086*	*0,086*	*0,086*	*0,086*	*0,043*	*0,043*
Feeding equipment	*0,026*	*0,003*	*0,067*	*0,003*	*0,067*	*0,003*	*0,132*	*0,002*	*0,067*
Cages and equipment	*0,486*	*0,437*	*0,437*	*0,437*	*0,437*	*0,437*	*0,437*	*0,437*	*0,437*
Logistic cost total	***0,698***	***0,564***	***0,601***	***0,582***	***0,610***	***0,576***	***0,673***	***0,530***	***0,564***
Change in production cost	***0,000***	***-0,133***	***-0,096***	***-0,116***	***-0,088***	***-0,122***	***-0,025***	***-0,168***	***-0,134***

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Micro economy: summary

- **With all aternative methods profitability will increase if production is allowed to increase or many small units merged to a big unit**
- **Low value fish removal as a compensation do not decrease the production costs if the company is a big one with a small share of the fixed costs**

Production cost by volume	Business as usual	Baltic feed	Low value fish	Centralizing
Volume in cost breakdown	300 ton	450 ton	450 ton	300 ton
Variable cost	2,67	2,71	2,81	2,61
Semi variable cost	0,34	0,34	0,34	0,27
Fixed cost	0,79	0,53	0,53	0,79
Production cost	**3,80**	**3,58**	**3,68**	**3,67**
Production volume (ton)	Production cost	Production cost	Production cost	Production cost
300	**3,80**	3,84	3,94	**3,67**
450	3,54	**3,58**	**3,68**	3,40
600	3,41	3,40	3,48	3,27
1200	3,21	3,31	3,31	3,07

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Macro economy: summary

• **On the level of the national economy the practical constraints are taken into account:**

1. Baltic Sea Feed: 2 000 tons assumed production increase is based on present production figures, compensation factor value and on interviews of the farmers

2. Low value fish removal: 500 tons assumed production increase is based on evaluation of regions where the lv fish, fishermen and fish farmers are encountering each others

3. Spatial planning: 3000 tons assumed production increase is based on recognised potential farming regions and on the willingness of the companies to invest on those areas

•**Total effect: ? Finnish production * 2**

	Potential increase ton of fish production	Realistic increase ton of fish production	Direct production value Million of euros	Indirect. added production value Millions of euros	Employment direct person years	Indirect. added employment person years
Baltic feed	4 000	2 000	11	22	106	220
Compensation fishing	4 000	500	3	6	27	55
Spatial planning	10 000	3 000	16	32	119	285

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Regional economy: summary

- **Sout-Western Finland, the rural archipelago area**
- **Value added with indirect effects total 55 million euros**
- **Employment increases with indirect effects about 450 person year to the region**
- **Domestic fish production increase about 3 250 000 kg**
- **Other market effects? Availability of local fish, better fish selection on the market, prices down ?**

	Potential increase ton of fish production	Realistic increase ton of fish production	Direct production value Million of euros	Indirect. added production value Millions of euros	Employment direct person years	Indirect, added employment person years
Baltic feed	1 500	1 000	6	11	53	110
Compensation fishing	2 000	250	2	3	13	27
Spatial planning	5 000	2 000	11	22	80	166

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Johtopäätökset

1. Significant economic impacts if production figures are allowed to increase

- **Management should take the incentives to form an essential part of the system**
- **Depends on the incentives how extensive the application of the methods will be**

2. Voluntary – no enforcement

- **Availability of raw materials may change**
- **Practical contraints for some companies**
- **Profitability low -> incentives only**

3. If no incentives, which the consequences will be?

- **Disappering of the domestic fish from the market?**

4. Low value fish, feed fish, should be used as human nutrition

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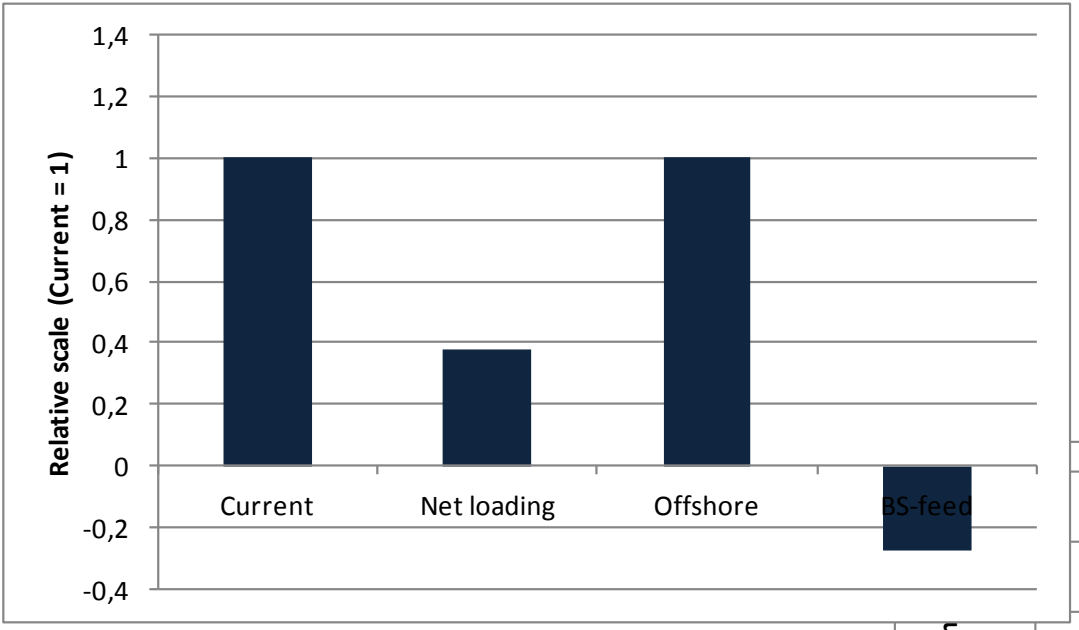
Eutrophication vs. climate change



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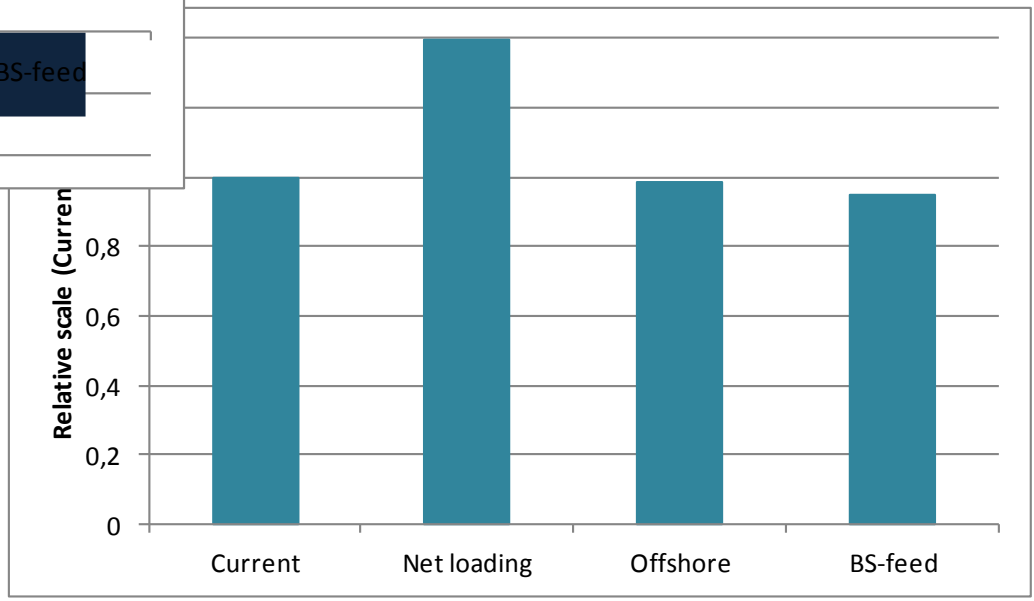

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Conclusions

Fish produced with Baltic Sea feed in (more) open sea areas is the most sustainable way to produce animal protein

1. Its environmantal impacts may be less than that of chicken, beef, or pig production
2. Healthy food stuff
3. Market based prices: no direct production support

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Recommendations

- The Baltic Sea feed should be taken into use
- The national site selection plan for aquaculture should be put into practice through a concrete system with clear terms. The system should be an essential part of the aquaculture permit process
- Marine spatial planning should be developed further with regional co-management as a goal
- Removal of LVF should be encouraged through economic support to the fishermen and fish farmers
- Removal of nutrients in the form of LVF should be taken as a compensation measure as one possible part of the aquaculture permits
- All management tools should be encouraged through planned incentives and by avoiding obligatory rules or enforcement because of the danger posed to profitability

Thank you for your attention

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http://www.coexistproject.eu/images/COEXIST/case_studies/COEXIST_Baltic_Case_Study_Report_FINAL.pdf