Systems Approach Framework Introduction-2

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A SYSTEM APPROACH FRAMEWORK FOR COASTAL RESEARCH & MANAGEMENT

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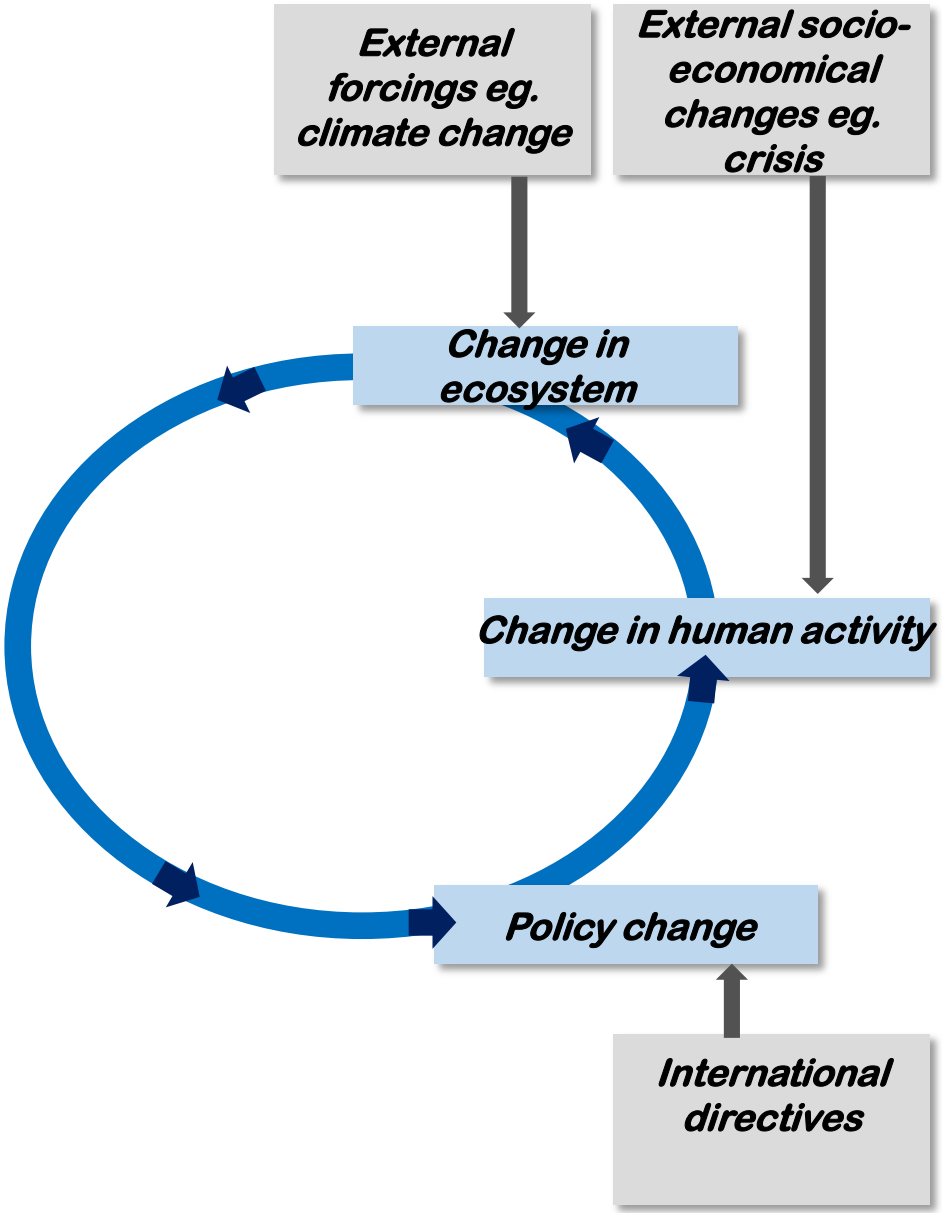
Systems Approach Framework

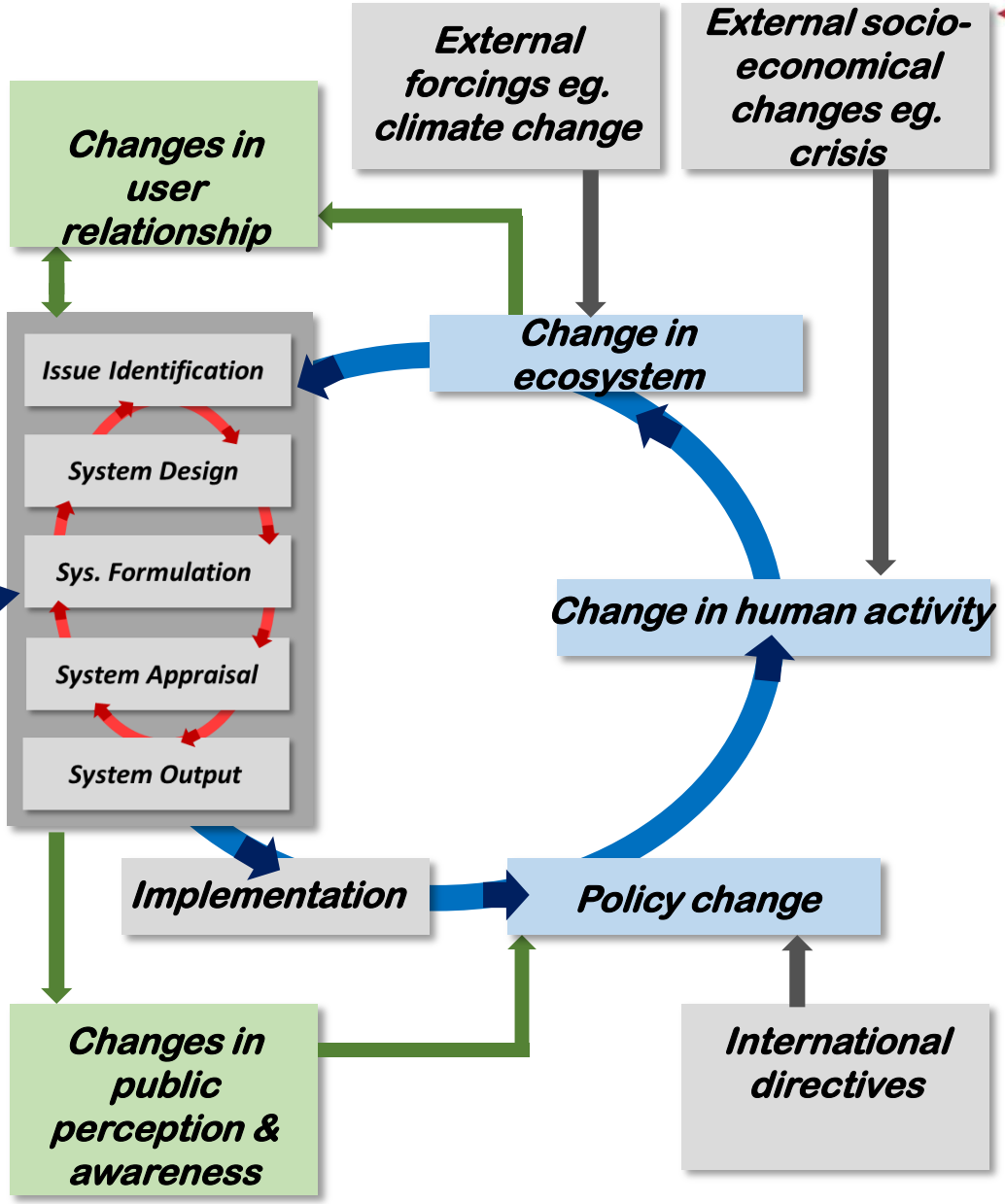


Bonus Baltcoast

Systems Approach Framework

Systems Approach Framework (SAF)

ESE - assessment



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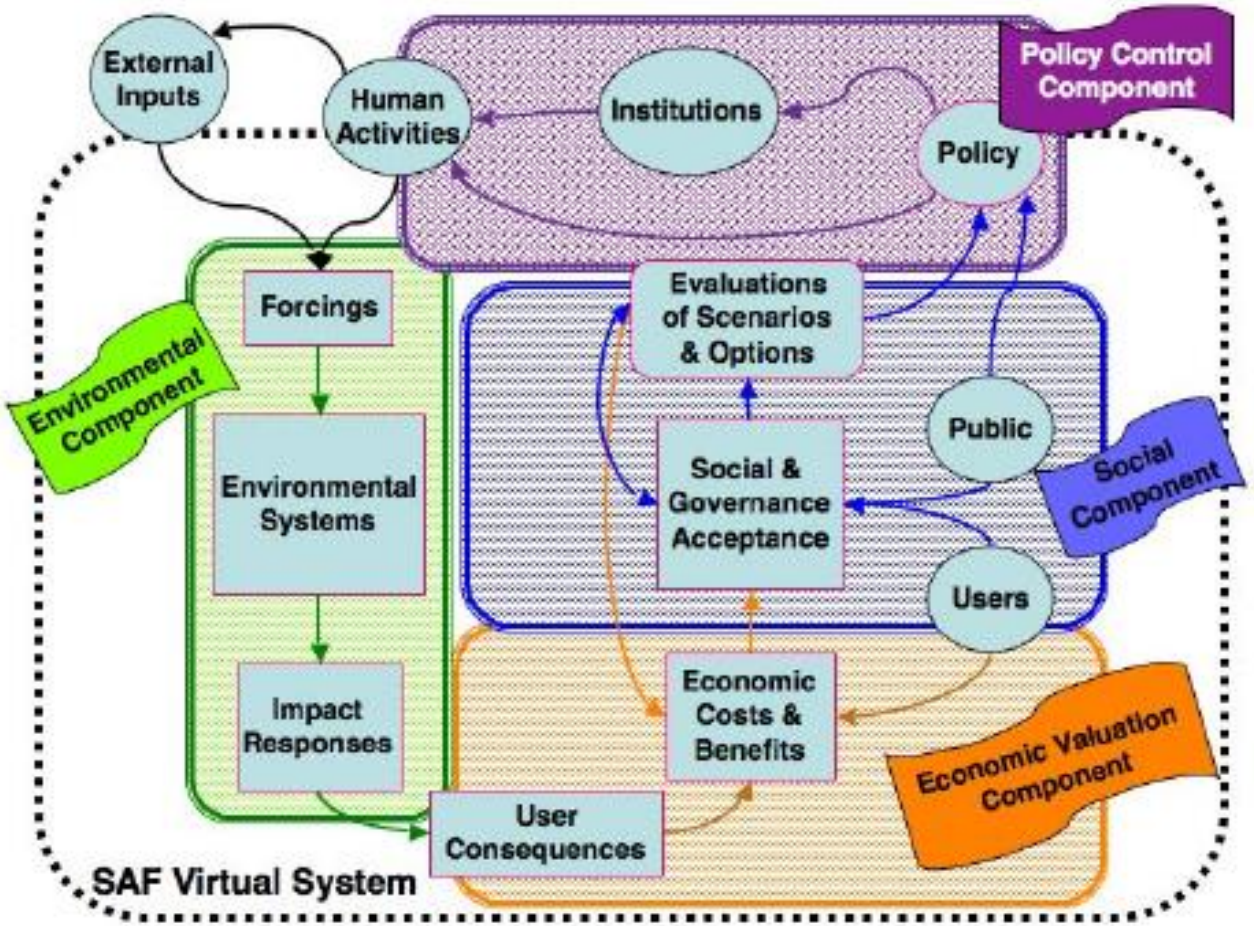
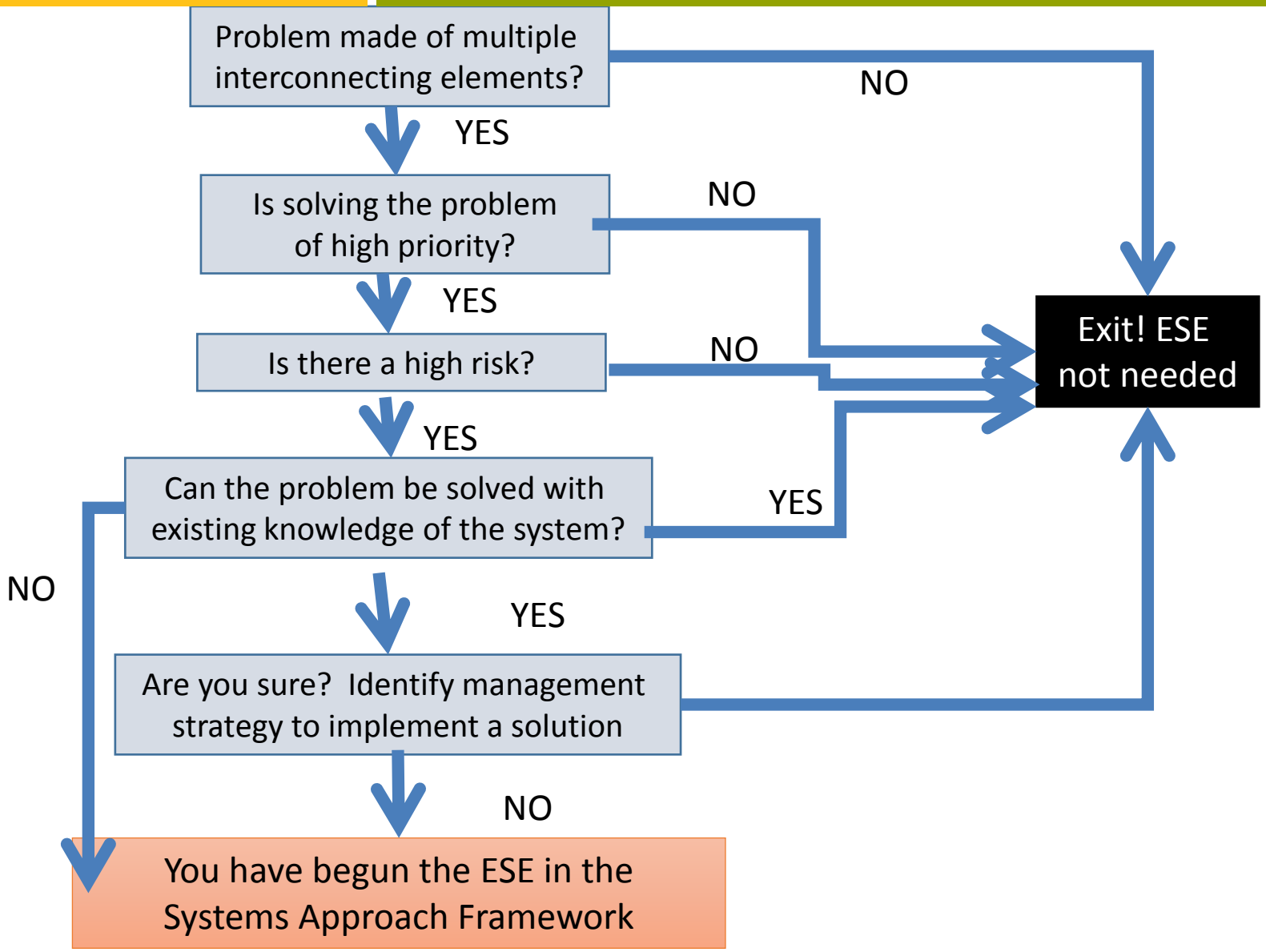


The SAF Virtual System domain with major Components and Interactions.

Each Ecological-Social-Economic (ESE) component has differing dynamics and function, types of information, and spatial-temporal scales. Need to be simulated as interacting components.

Forth component – Policy Control is not simulated but output of ESE simulation is the information input for Policy.

Do we need to run an ESE assessment?



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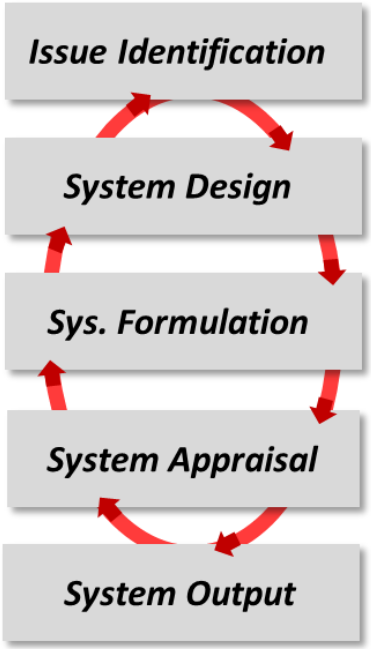
ESE assessment



Identifying the Policy Issue(s)
Mapping stakeholders
Institutional mapping
DPSIR, CATWOE

Conceptual models
System boundaries

Generating systems model
Calibration and validation
Preparing scenarios

Linking ESE model components
System simulation of scenarios

Running scenarios
Presenting to stakeholders
Evaluation

Example of SAF with ESE assessment

Limfjord Denmark

Dinesen, Støttrup et al. 2011
Timmermann, Dinesen, Støttrup et al. 2014

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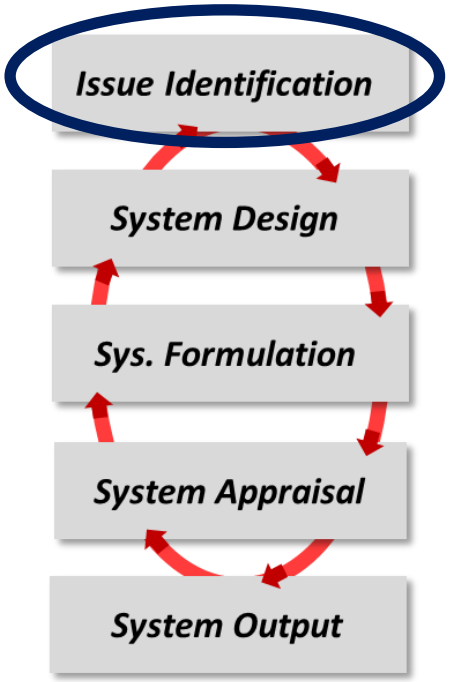
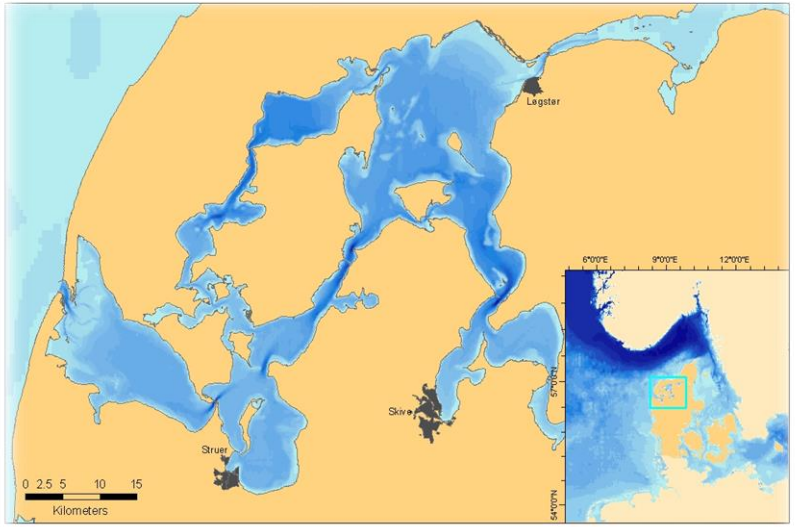
Issue Identification Step



The Problem:

Eutrophicated fjord

Implementation of Water Framework Directive



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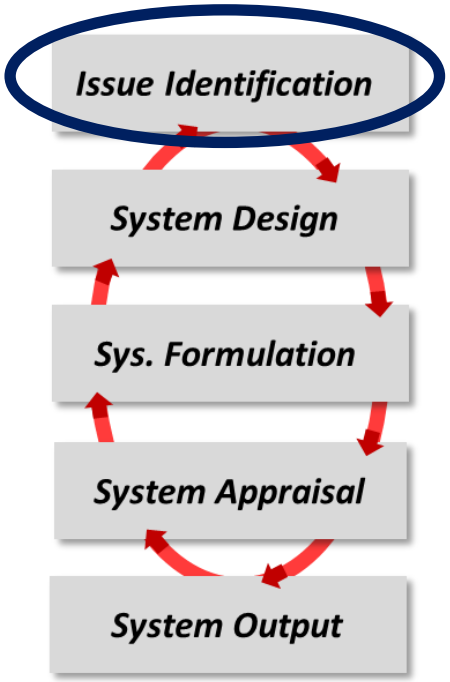

Stakeholder mapping
Insitutional mapping

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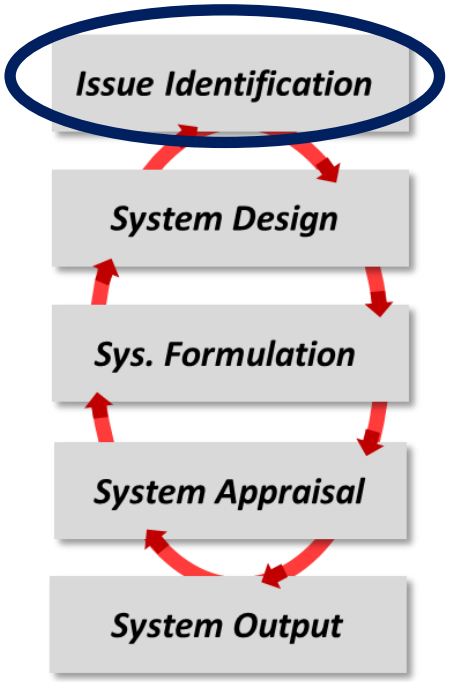
Stakeholder forum



Stakeholder meeting.
Concerns
Who is concerned about what relative to the problem?

Disccusing the problem,
Iidentifying the Issue
Prioritising the Issues at a Stakeholder forum.

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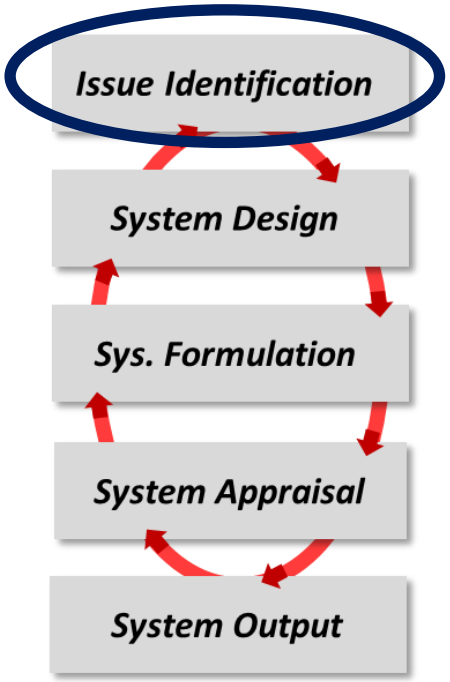
Policy Issues decided upon in this example



1) regulation of nutrient effluents to reduce eutrophication;

2) closure of the mussel fishery due to national implementation of international directives

3) resolve resource conflicts between mussel fishers and mussel farmers.

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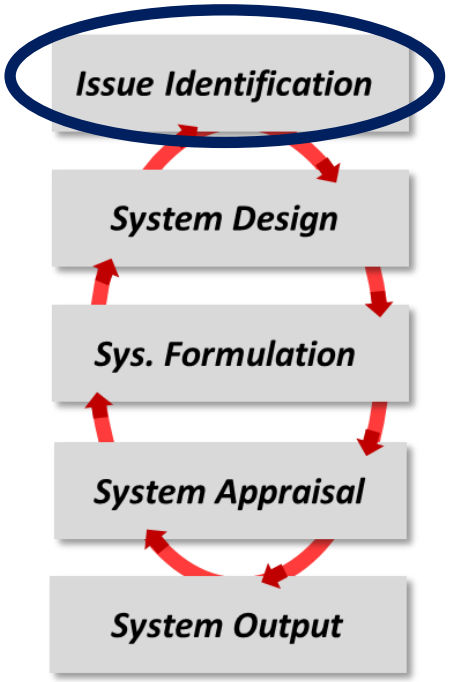
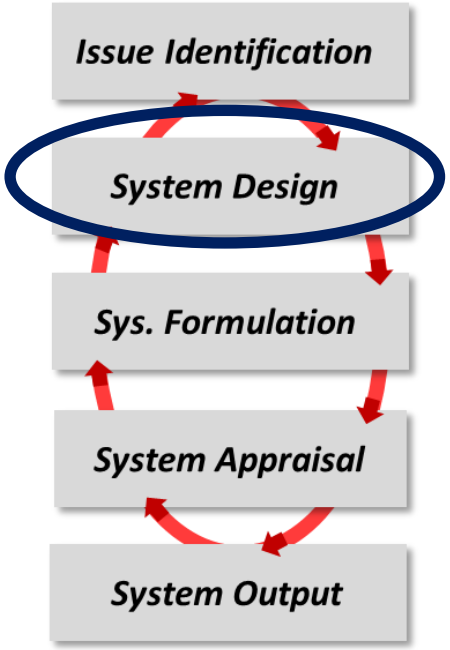
DIPSIR and CATWOE



For that Issue identified:
Identify the Drivers and Pressures of the system, who is involved etc.:
DIPSIR
CATWOE

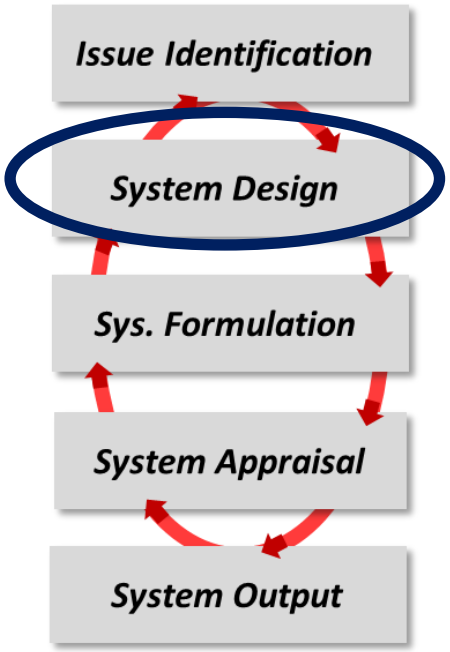
System Design



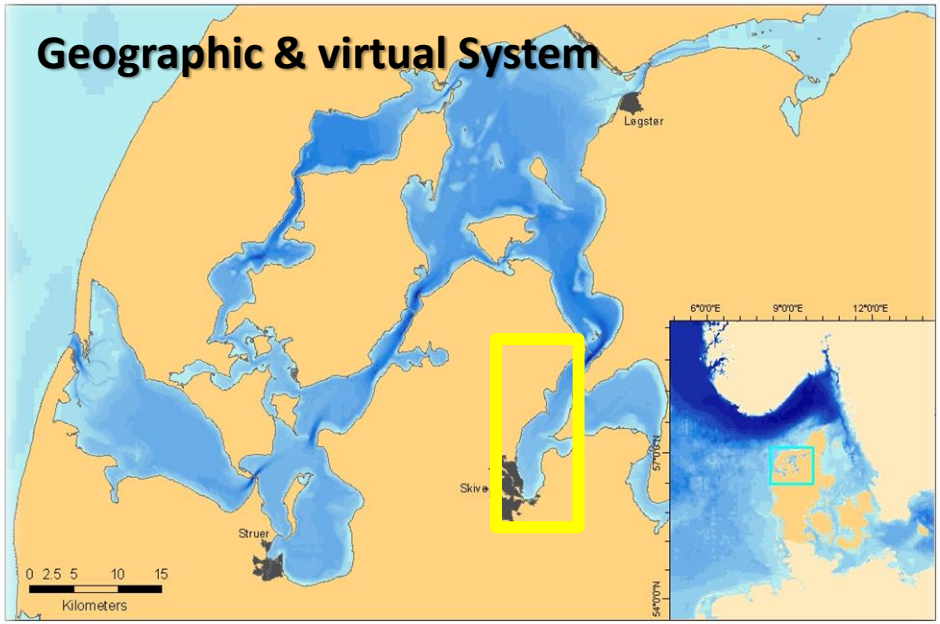
- System Definition
- Conceptual Model
- Data and Methods
- Problem Scaling

Systems Approach Framework

System definition



- Define Virtual System (boundaries)
- Define Administrative boundaries
- Define linkages between the three ESE components



Limfjord:
Social & Economic components

Skive Fjord:
Ecological component

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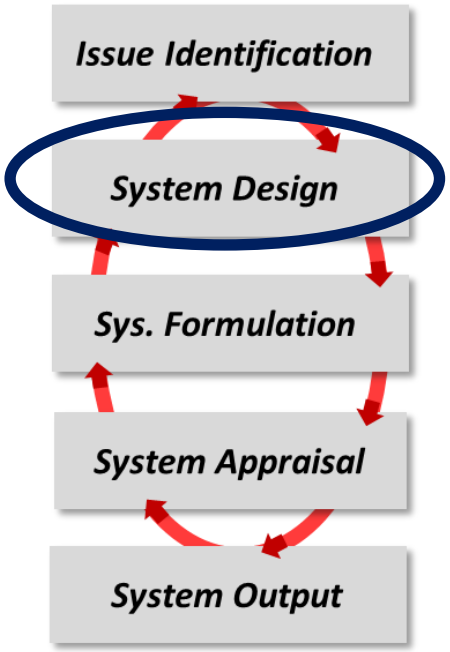
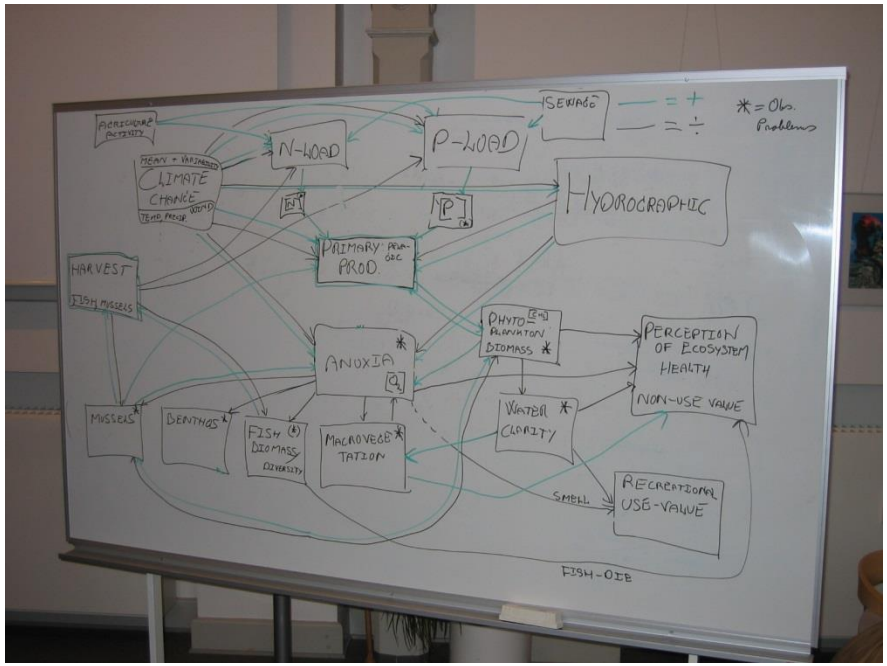
Conceptual model



The first attempt at a conceptual model



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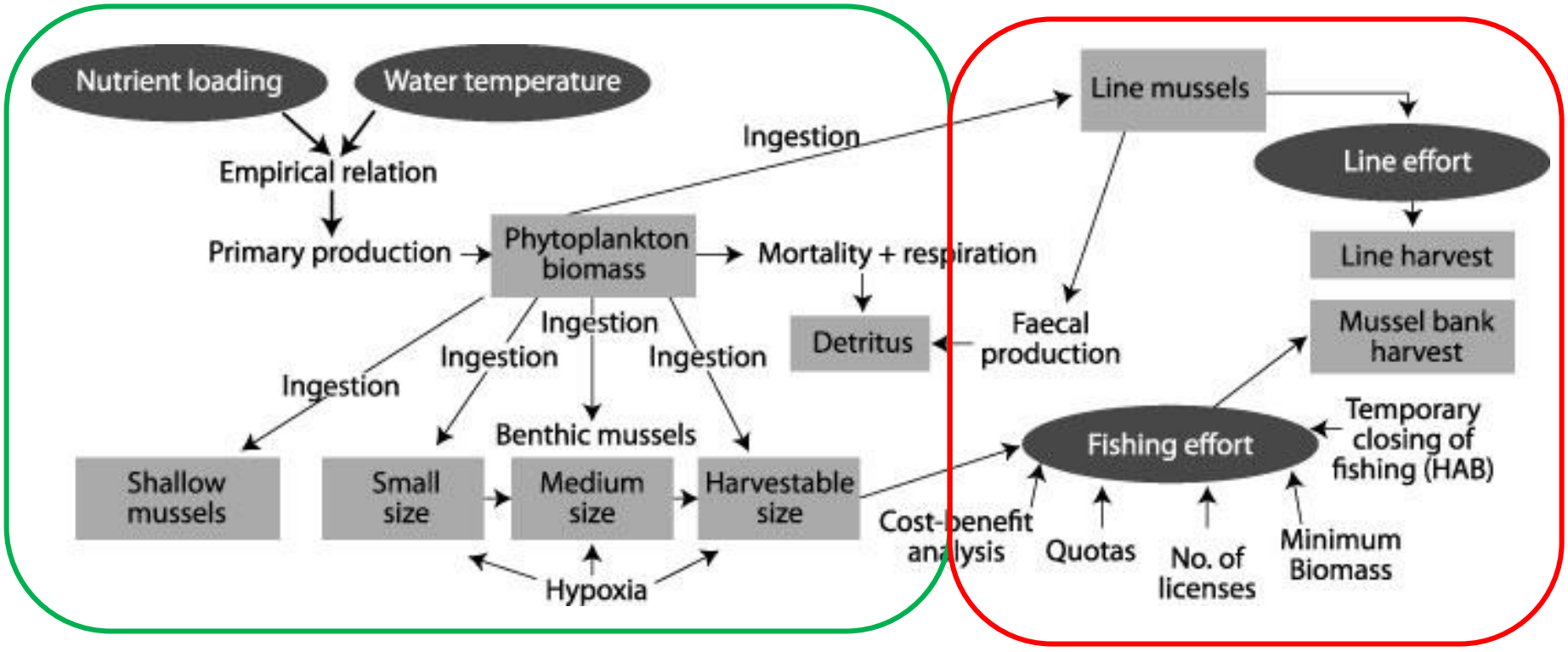
SYSTEM DESIGN - conceptual model developed



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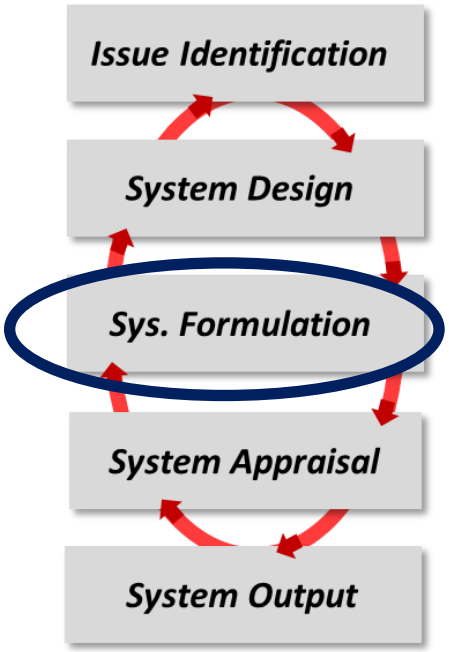
System Formulation



Developing sub models
Calibration and validation

System formulation

Ingestion of phytoplankton by the i´te group of mussels

$$I_i = T \cdot l_{\max\_i} \cdot \left(\frac{D_i \cdot PB}{D_i \cdot PB + K_{1/2}} \right) \cdot M_i$$

Temperature

Max. ing. rate

Phytoplankton concentration

Mussel fishery – profit function

$$\pi = pY - C_f - Cv$$

Price - 1000 € Ton^{-1}

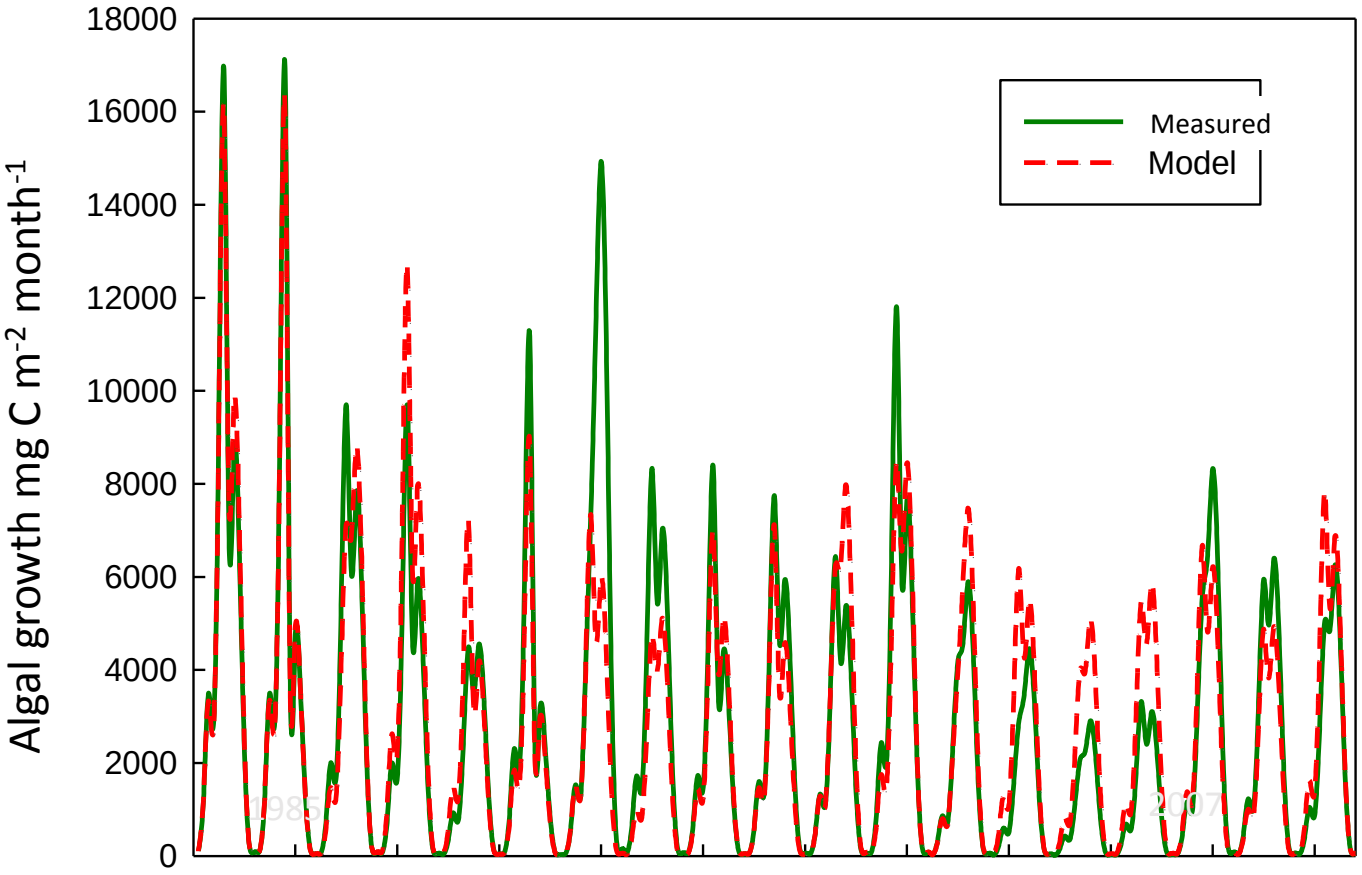
Yield - Tons

Fixed costs

Variable costs - 1000 € day^{-1}

Timmermann et al., submitted

Model validation – primary production, Skive Fjord



(from Markager et al.)
Timmermann et al. 2014

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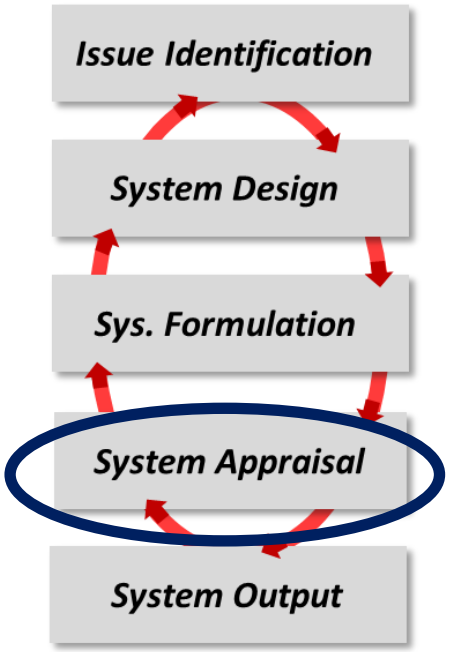
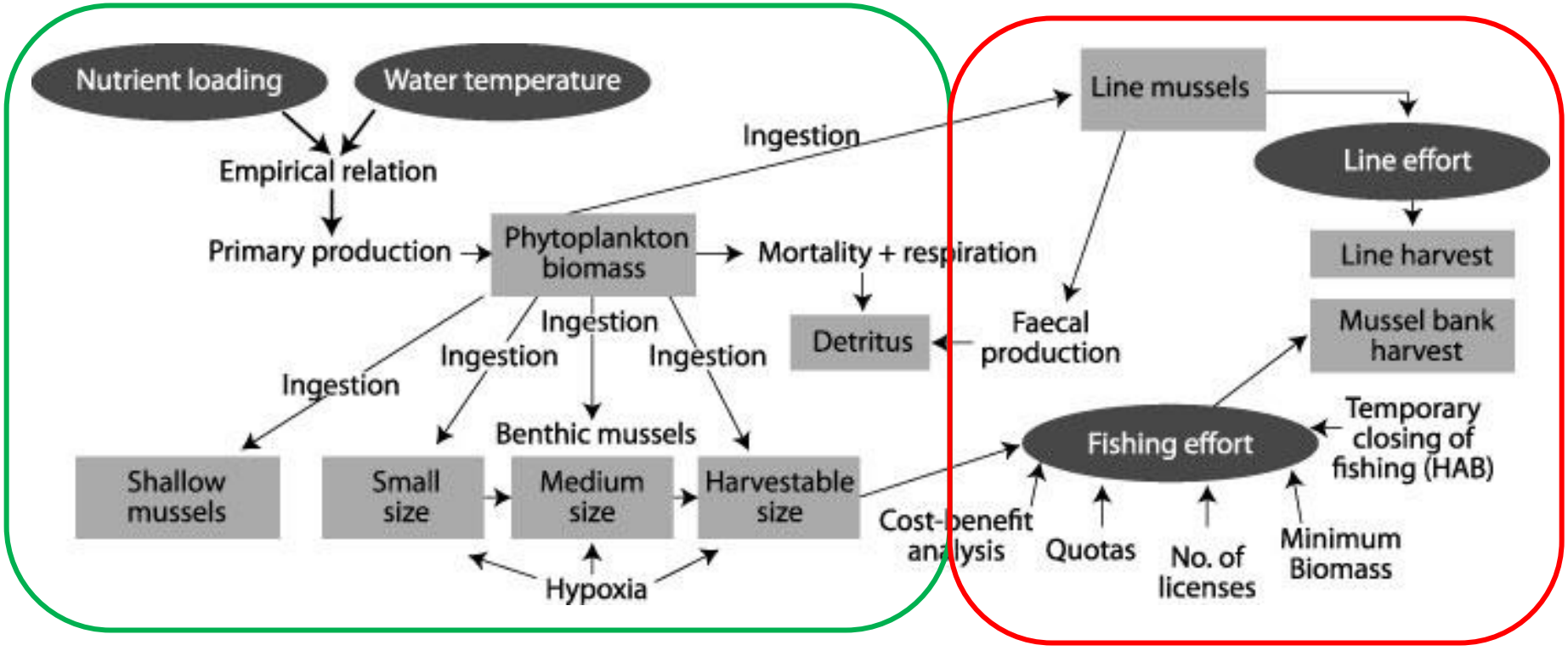
System Appraisal



Generating systems model
Calibration and validation
Preparing scenarios

Systems Approach Framework

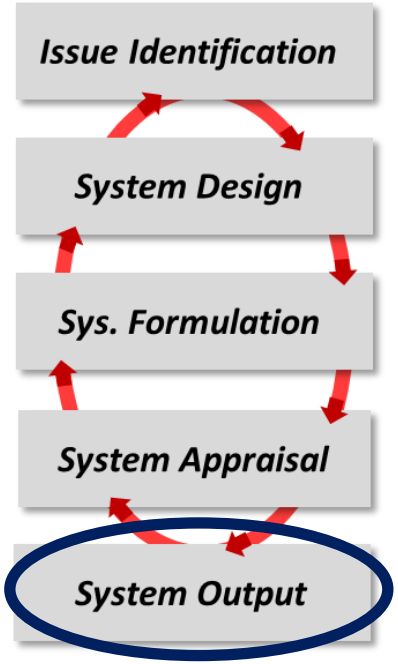
SYSTEM APPRAISAL - systems model



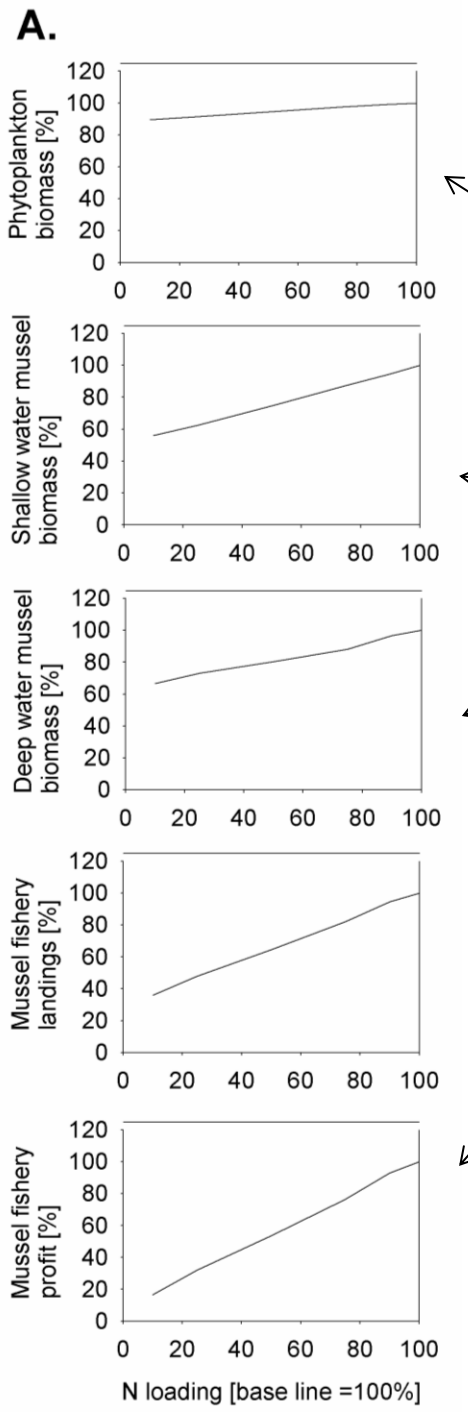
Bio-economic model with the links between sub-models established for mussel farming and mussel fishery.

Systems Approach Framework

Scenario simulations



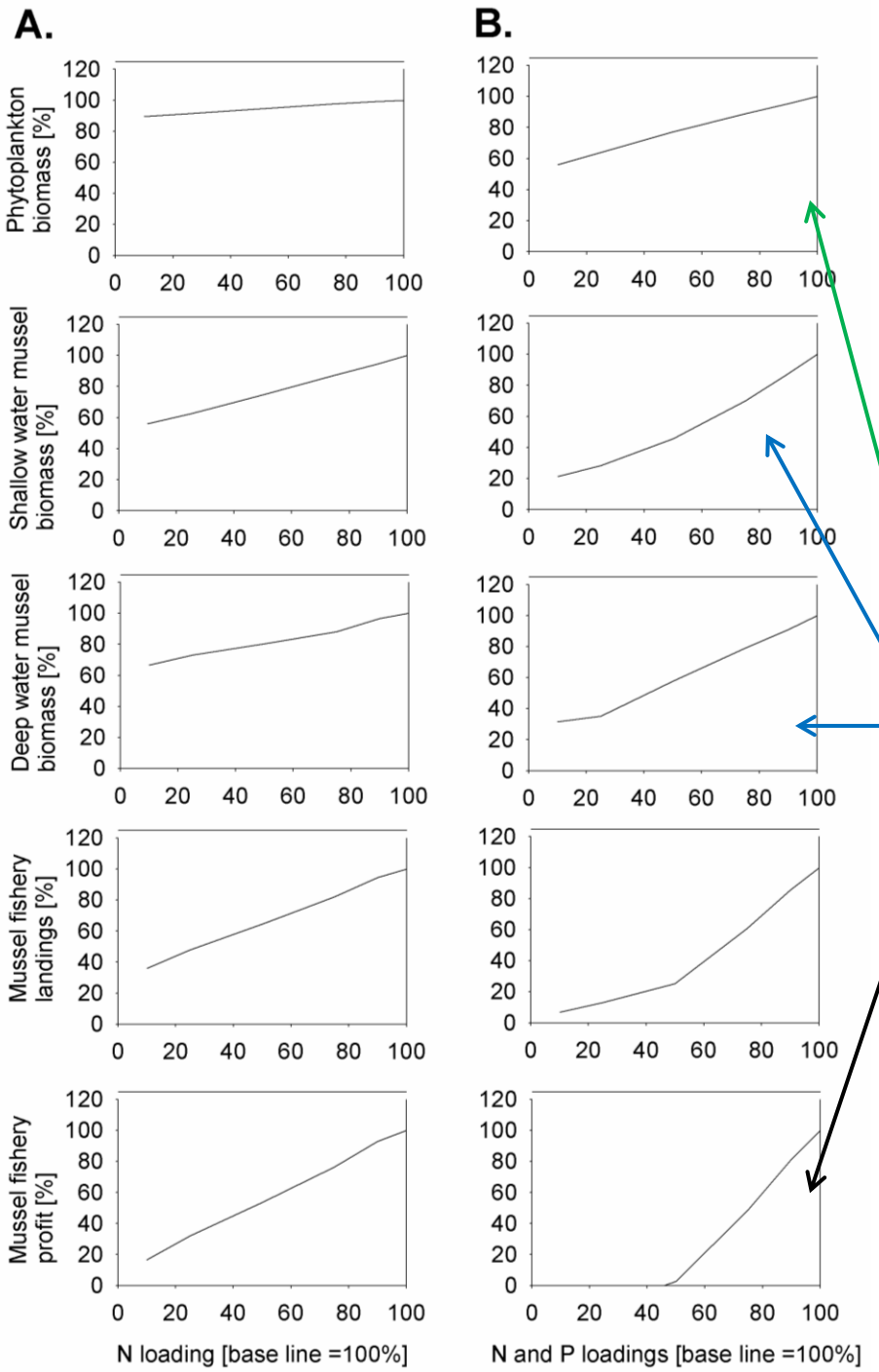
1) reductions of Total N and P
2) closure of the wild mussel fishery
3) introduction of line-mussel culture



RESULTS of Scenario 1. Reductions of total N and P loadings

Reductions in N alone to WFD target (47% level) showed:

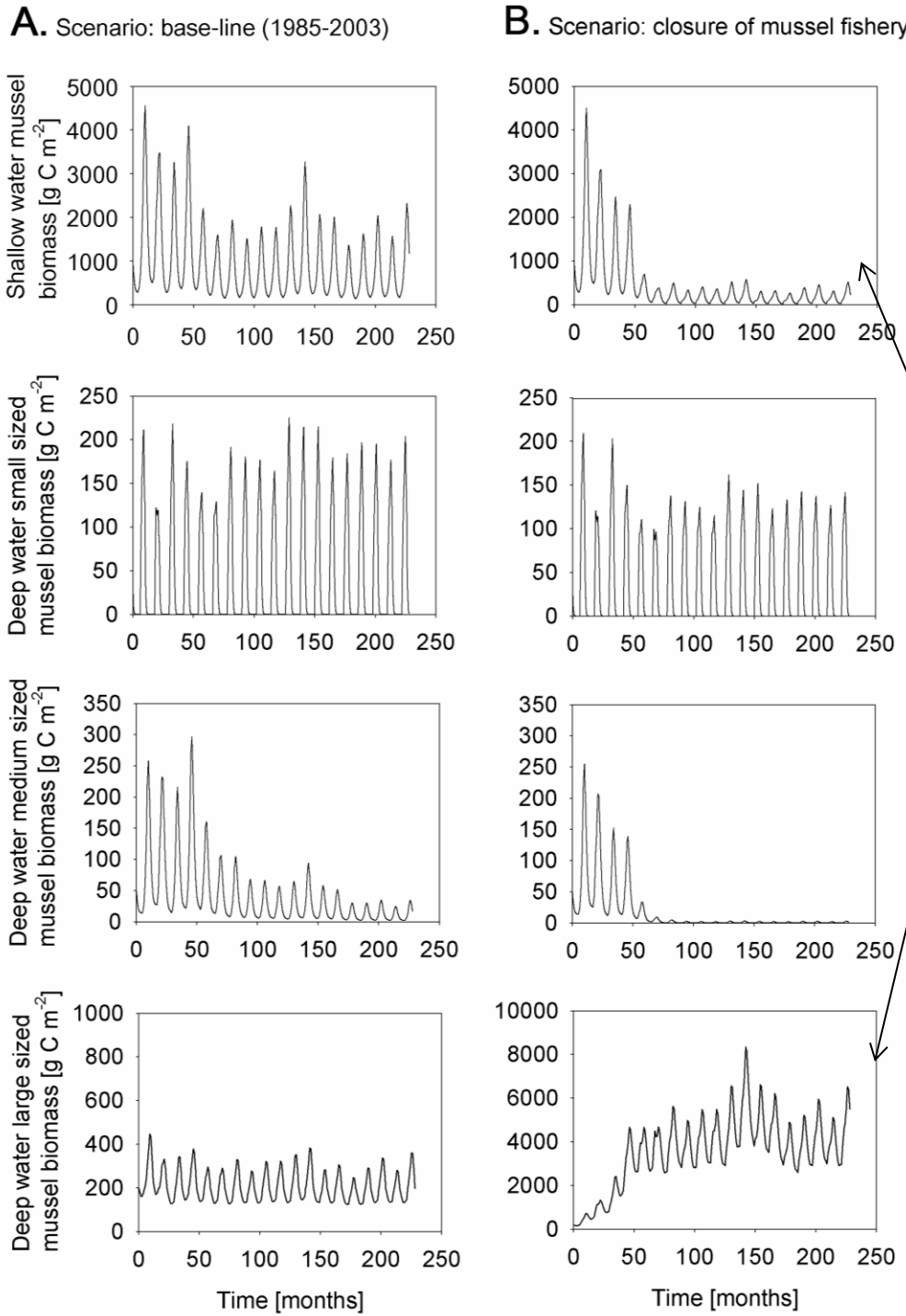
1. **Minor decrease in phytoplankton biomass**
2. **Decrease (~25%) of shallow and deep water mussel biomass**
3. **Decrease (~50%) of mussel fishery profit**



RESULTS of Scenario 1. Reductions of total N and P loadings

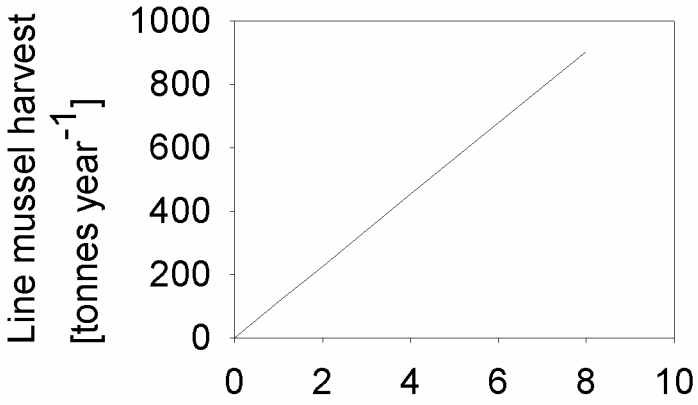
Reductions in N and P to the 47% level would result in:

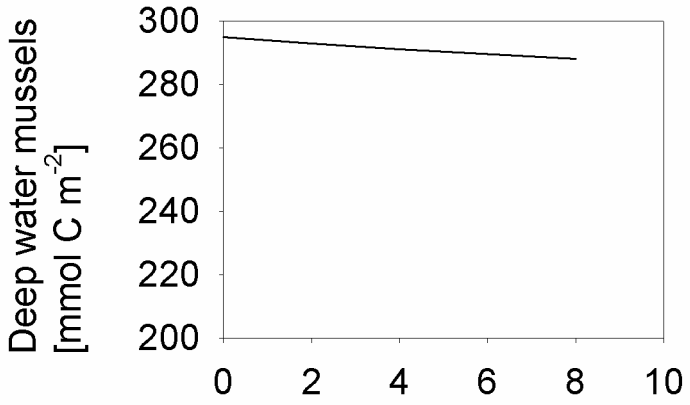
1. **Minor decrease in phytoplankton biomass (~20%)**
2. **Decrease (~50%) of shallow and deep water mussel biomass**
3. **Almost collapse of mussel fishery**

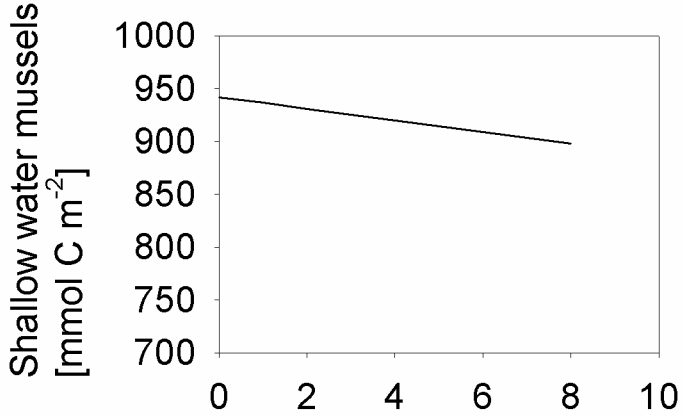


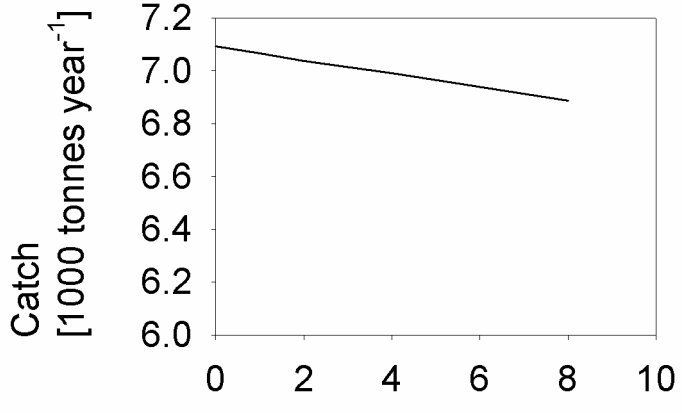
RESULTS of Scenario 2. Closure of wild mussel fishery

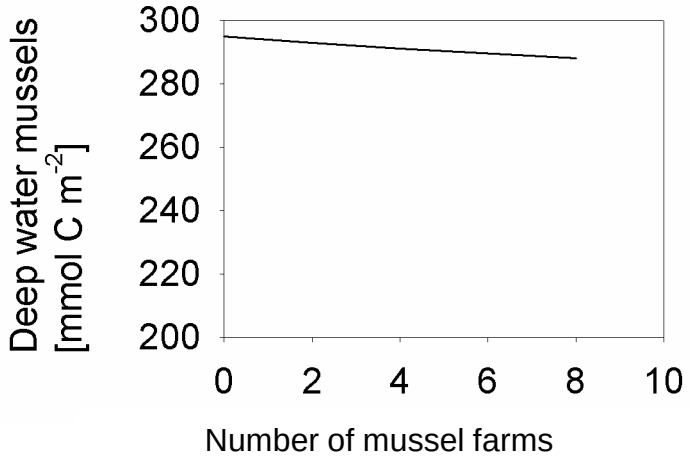
1. a >10 fold increase in hitherto fishable mussel biomass
2. a >10 fold decrease in **shallow-water** and medium-sized deep-water mussel biomass
3. an annual profit loss of ~€6.2 million

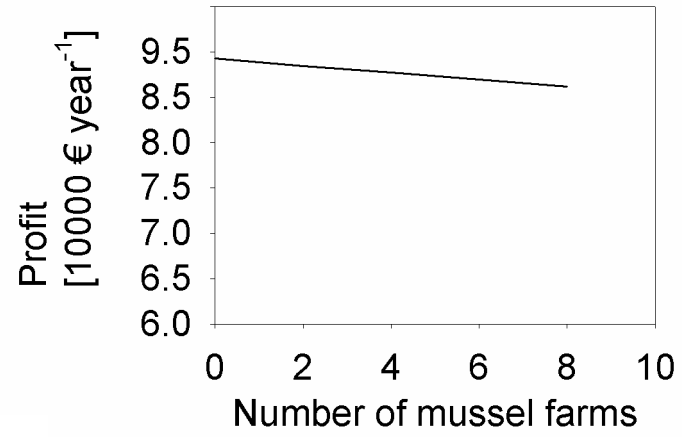












RESULTS Scenario 3. Introduction of line mussel culture

had little impact on wild mussel fishery
had little impact on shallow-water mussel biomass

Systems Approach Framework

Scenario simulation results provided

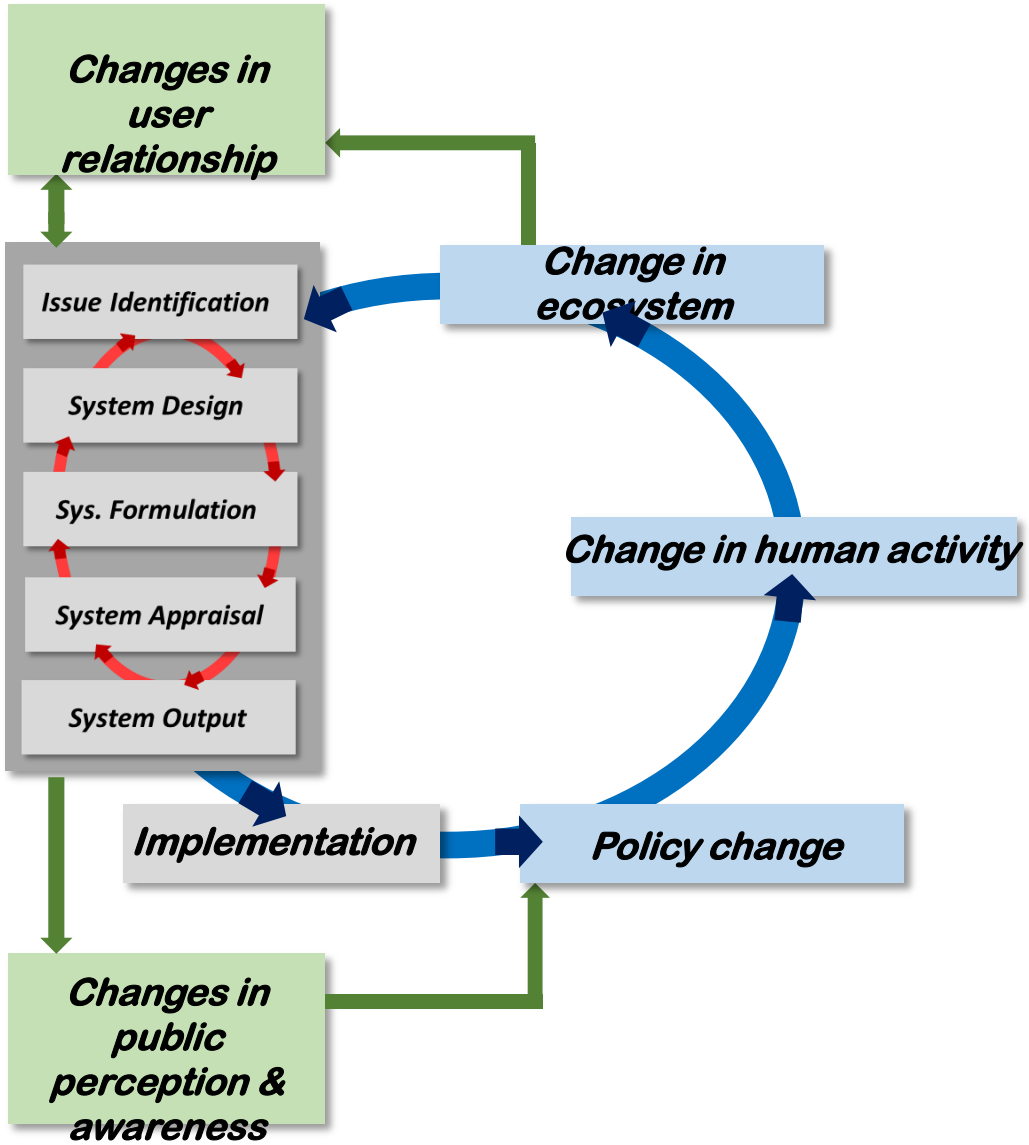
- both recognizable and unexpected results, which stimulated discussion among stakeholders
- credible overview of the ecosystem they were familiar with
- cognition of a higher ecosystem complexity than hitherto understood
- changes in stakeholder perceptions

The SAF seems well qualified for developing a common understanding of the needs and consequences of change as part of the public consultation process and merging public and scientific information.



Systems Approach Framework

Systems Approach Framework (SAF)



Example of a SAF application without quantitative modelling within the ESE assessment.

Eel management plan

Different eel fishers (recreational and commercial) also with different gear types and fishing customs.

4-5 management options set up by Ministry and ministerial advisors.

Traditionally an option would be chosen and open consultation takes place with possibility of adjustments but also risk of public outcry and/or heavy opposition.

Stakeholder discussions on management options resulted in all options being openly discussed but also alternative management options being suggested.

The option chosen by Ministry was one of the resulting options from the meeting. This resulted in higher compliance and no public outcry.

Systems Approach Framework 1

- Systems Theory is about understanding complex and large-scale interactions based on our perceptions of the world.
- It requires broad multi-disciplinary experience as is represents a mixture of scientific knowledge and intuition needed to understand the behaviour of complex systems (Hopkins et al. 2011).
- It also involves good communication skills at all levels

Systems Approach Framework 1

Sustainable ICM is grounded in principles of good governance

- ✓Accountability
- ✓Transparency
- ✓Openness

SAF provided the Framework for a sustainable ICM process.

BONUS BaltCoast

DTU

Questions?

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