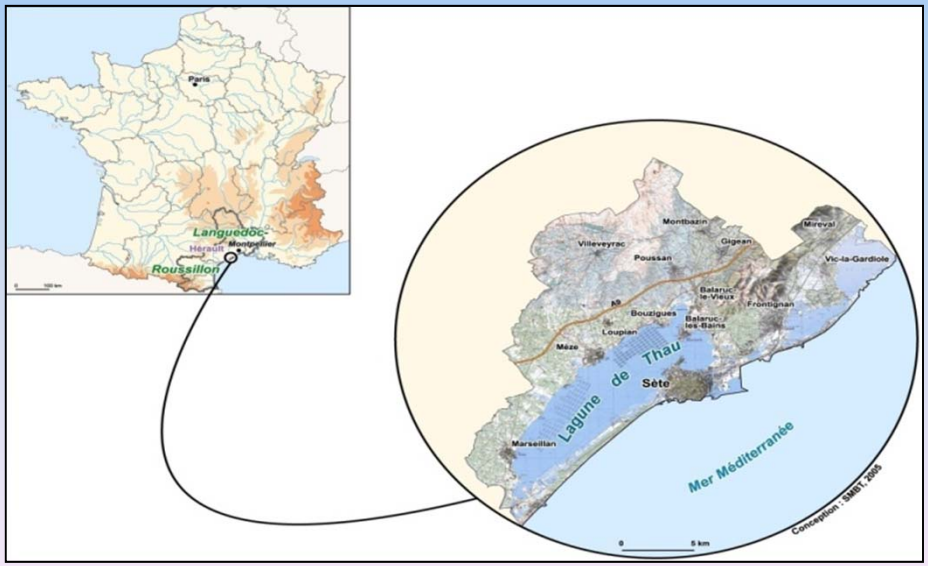
# Exploratory modelling of the shellfish farming vulnerability of the Thau lagoon face to the microbiologic contamination

**José A. Pérez Agúndez[1], Alice Vanhoutte-Brunier[2], Rémi Mongruel[1], and Eden Yimam[2]**

(1) Ifremer / UMR-Amure/ Marine Economics Unit
(2) UBO/UMR-Amure université de Brest




CONTACT

Ifremer

**Daniel Roy, SPICOSA Project Manager,** daniel.roy@ifremer.fr

**Denis Bailly, SPICOSA Scientific Coordinator,** denis.bailly@univ-brest.fr

**Tom S. Hopkins, SPICOSA Scientific Coordinator,** tom.hopkins@iamc.cnr.it

Website: www.spicosa.eu

SIXTH FRAMEWORK PROGRAMME

An integrated project under the EU´s 6th Framework Programme for Research (FP6) of the European Commission

# An overview of the policy issue in Thau study site

✓ The main issue: the microbiological contamination of the lagoon (component of the local water policy)

✓ local demographic development (increase of environmental pressure including microbiological contamination)

✓ The microbiological contamination raises four basic questions:

1) What are the impacts of microbiological contamination on shellfish farming and other human activities in the lagoon ?

2) What are the main contamination sources ?

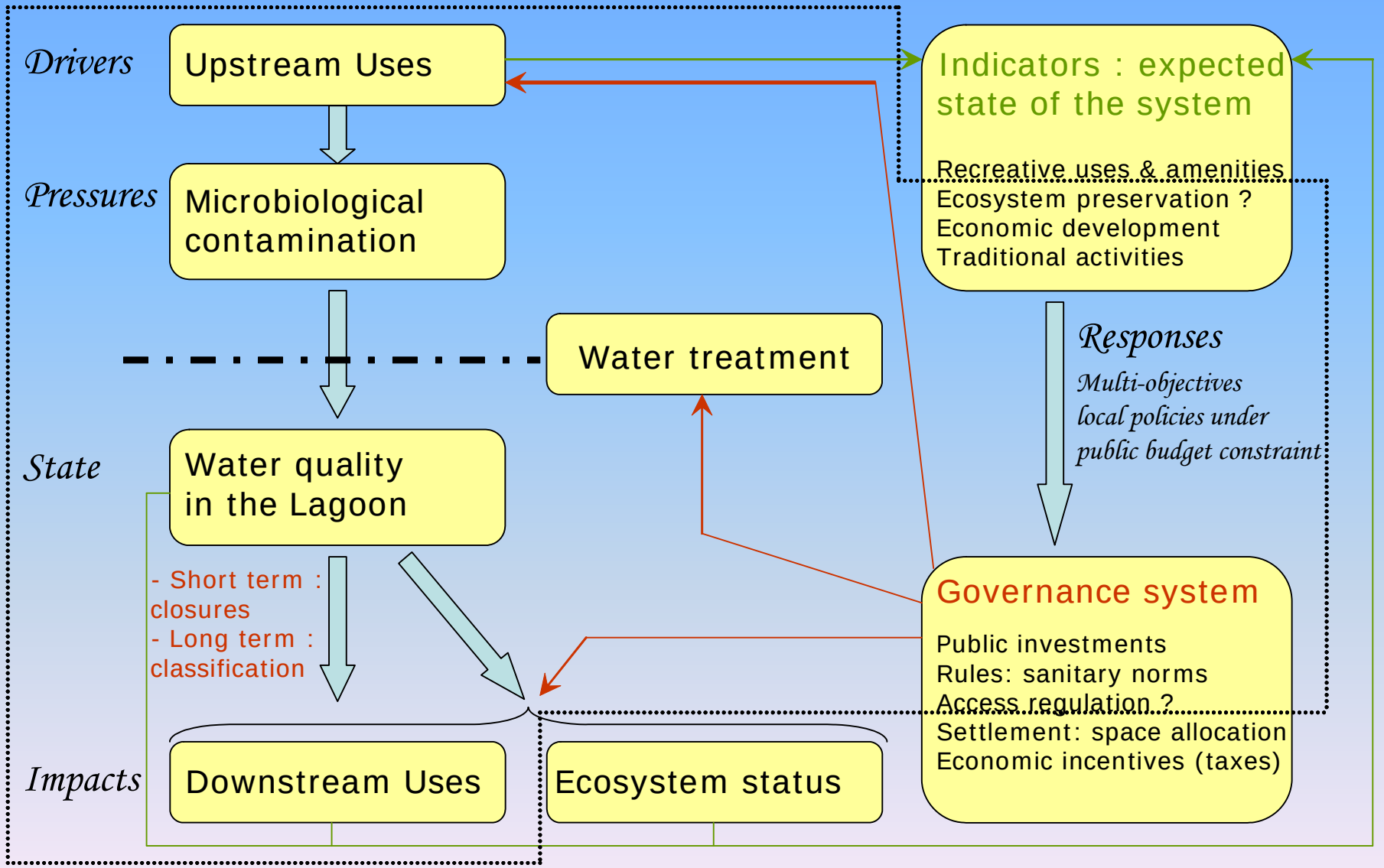
3) What is the efficiency of the current water treatment system as regards microbiological contamination ?

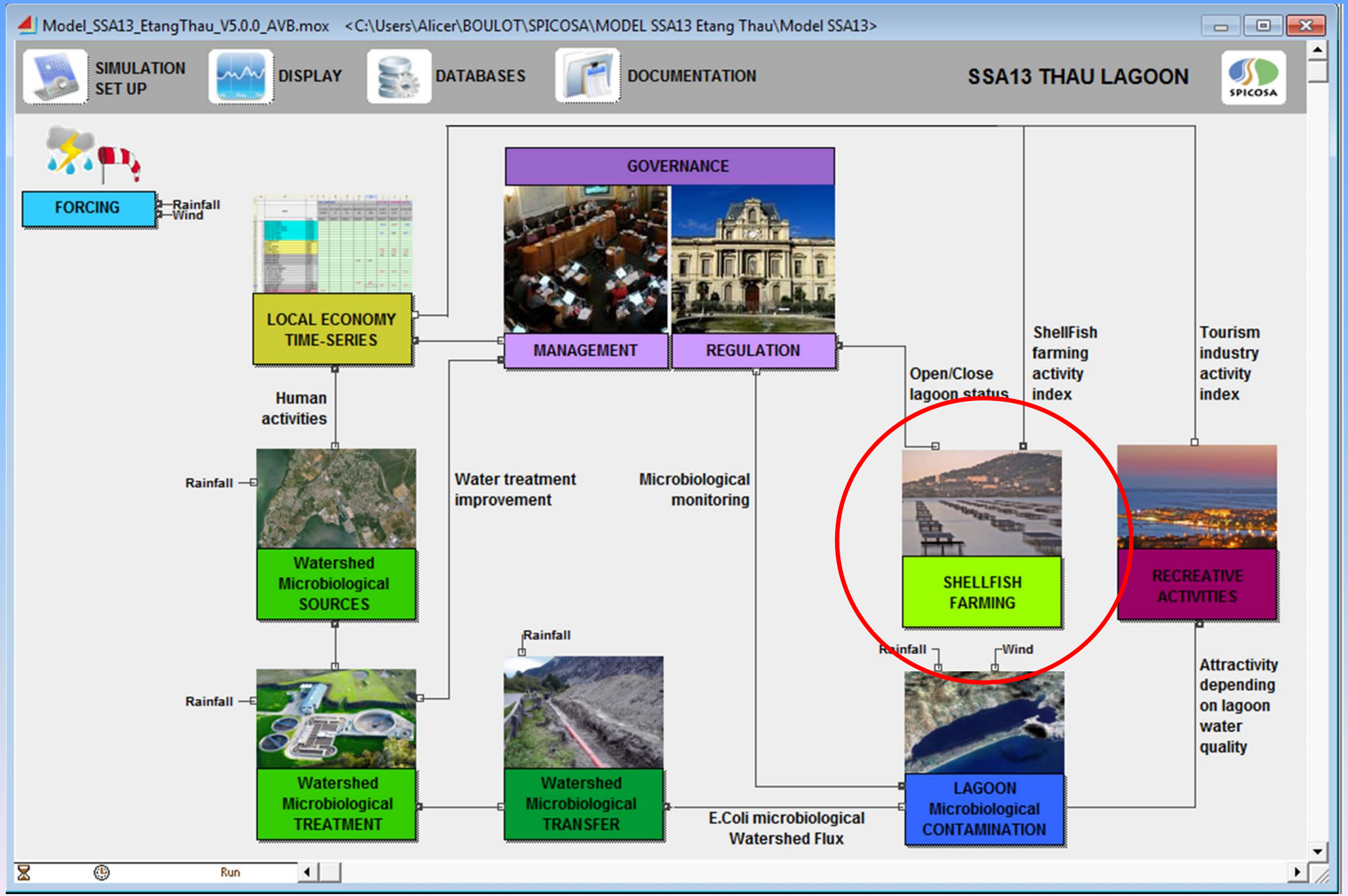
4) Which management options would reduce the impacts of MC in a way which would be coherent with the more global local policy objectives ?

✓ Spicosa aims to integrate the existing knowledge (e.g. OMEGATHAU).

# The system and its components

## Managing the microbiological contamination of the Thau Lagoon




Model_SSA13_EtangThau_V5.0.0_AVB.mox <C:\Users\Alicer\BOULOT\SPICOSA\MODEL SSA13 Etang Thau\Model SSA13>
SIMULATION SET UP
DISPLAY
DATABASES
DOCUMENTATION
SSA13 THAU LAGOON
SPICOSA
FORCING
Rainfall
Wind
GOVERNANCE
LOCAL ECONOMY TIME-SERIES
MANAGEMENT
REGULATION
Human activities
Open/Close lagoon status
ShellFish farming activity index
Tourism industry activity index
Rainfall
Water treatment improvement
Microbiological monitoring
Watershed Microbiological SOURCES
SHELLFISH FARMING
RECREATIVE ACTIVITIES
Rainfall
Rainfall
Wind
Rainfall
Watershed Microbiological TREATMENT
Watershed Microbiological TRANSFER
E.Coli microbiological Watershed Flux
LAGOON Microbiological CONTAMINATION
Attractivity depending on lagoon water quality
Run

# The economic dimensions

Economic dimension 1: cost-effectiveness analysis of the water treatment systems, according to different technical options.

Approach = investment and running costs of water treatment settlements, considering local public budget constraints

Economic dimension 2: economic dynamics in the shellfish farming industry.

Approach = vulnerability of companies due to commercial bans

Economic dimension 3: a regional economy matrix will be used so as to provide macro-economic drivers and indicators at the site scale (territory).

Approach = incorporating direct (pressure and impacts) and indirect (induced effects) relationships between the environment and the macro-economic dynamics of the Thau Lagoon territory (economic feedback loops)

## Analysis of the shellfish farming sector vulnerability

- ✓ Vulnerability is the degree to which a system or unit is likely to experience harm due to exposure to perturbations or stresses (De Sherbinin et al. 2007).
- ✓ Vulnerability is multi-factorial and refers to the whole different shocks than individuals may support
- ✓ Vulnerability assessment: implementation on four of the eight steps proposed by Polsky et al. (2003)

1 define the study area in tandem with stakeholders;
2 become aware of the study area and its contexts;
3 hypothesize who is vulnerable to what;
4 develop a causal model of vulnerability;
5 find indicators for the components of vulnerability;
6 weight and combine the indicators;
7 project future vulnerability;
8 communicate vulnerability creatively

} into Spicosa

} Process for building indicators of vulnerability

- ✓ This will be used as the base of segmentation of the population on classes depending on their vulnerability to microbiologic contaminations.

# Causality of vulnerability

- The causality of vulnerability is structured following the notion of vulnerability from [White et al., 2005].

Vulnerability = (Exposure × Susceptibility)/(Coping capacity)

**(sensibility)**

- Applied to economic agents, vulnerability depends on external factors, some of them out of their control (e.g. seasonality, frequency of events, etc.), and on internal factors (e.g. degree specialization, the diversity of outputs, the profitability of the company, etc.) including structural and temporary states determining their resilience capacity for implement adaptive responses after a shock, a crises or a stress.

# How the shellfish farming box interacts into the model

**The output of the physical system is an input for the shellfish farming box**:

simulation of the number of days of commercial bans by year

**The output expected of the shellfish farming box is an input for the governance box including** :

1. Assessments of the economic impacts in terms of total revenue potentially affected by commercial bans (quantitative Inf.)
2. The distribution of companies depending on their vulnerability (qualitative Inf.)

**SURVEY (100 enquiries, 19 % population)**

# Vulnerability assessments

## 1.- Static vulnerability assessment : analysis of the shellfish farming sector

- ✓ Building indicators of vulnerability
- ✓ All vulnerability factors are static

## 2.- Dynamic vulnerability modelling

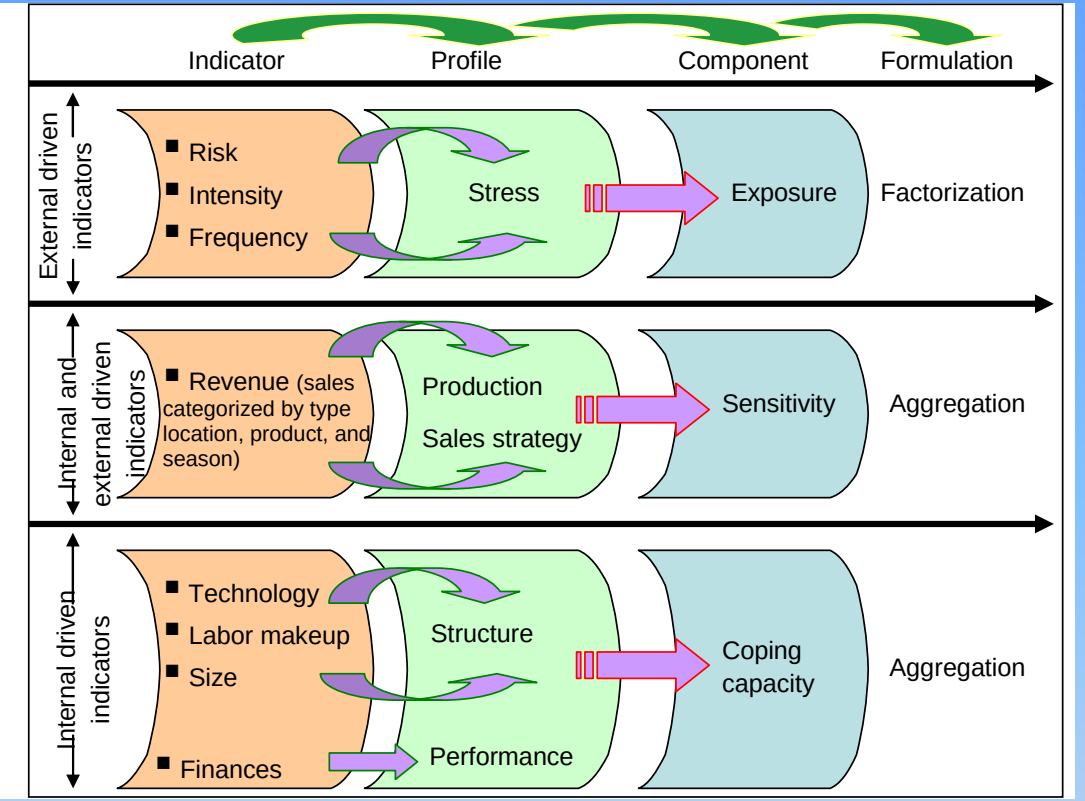
- ✓ integration in the Spicosa-Thau model
- ✓ All vulnerability factors are potentially dynamic
- ✓ In a first step only the risk of commercial ban changes

$$\Delta \text{ Vulnerability} = (\Delta \textbf{ Exposure} \times \text{ Susceptibility}) / (\text{Coping capacity})$$

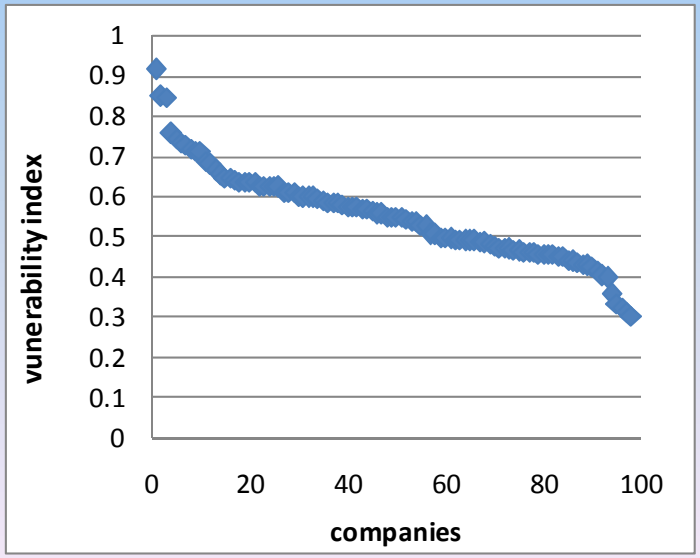
# 1.- Static vulnerability assessment : analysis of the shellfish farming sector

## 1.1.- Indicator Profile Framework

(seasonality,
specialization,
safeguard capacity,
etc.)




## 1.2.- Global results of scoring




| Company | Score interval | Number of companies | Vulnerability Scores |
|---|---|---|---|
| V++ | > 60 | 29 | 0.684 |
| V + | 50-60 | 29 | 0.563 |
| V- | 40-50 | 34 | 0.464 |
| V-- | < 40 | 6 | 0.339 |

## 2.- Dynamic vulnerability modelling

- ✓ Only the risk of commercial ban changes
- ✓ Scenarios which determine the risk of commercial ban
  - ✓Validation and reference scenarios (BAU)
  - ✓Scenario “demo” (implementation of the local town-planning (SCOT)
  - ✓Scenario “worst” (worst conditions of winds, demography and monitoring systems)
  - ✓Scenario “action” : implementation of measures planned concerning
    - the improvement of collecting networks
    - works on the wastewater treatment plants
    - the efficiency of pumping stations

# Preliminary results of potential impact on revenue

## Commercial bans simulations

| | 2002-2006 Reference | 2012-2016 Demo | 2012-2016 Worst | 2012-2016 Action |
|---|---|---|---|---|
| Winter | 8 | 8 | 12 | 6 |
| Spring | 0 | 0 | 30 | 30 |
| Summer | 20 | 20 | 30 | 24 |
| Autumn | 20 | 20 | 36 | 27 |
| Total | 48 | 48 | 108 | 87 |

## Potential impact by group of company

| | scenario "demo" | | scenario "worst" | | scenario "action" | |
|---|---|---|---|---|---|---|
| | companies | average impact | companies | average impact | companies | average impact |
| CL1 ++ | 18 | 1.58 | 55 | 1.60 | 3 | 1.55 |
| CL2 + | 56 | 1.24 | 30 | 1.24 | 55 | 1.18 |
| CL3 - | 16 | 0.87 | 8 | 0.84 | 27 | 0.86 |
| CL4 -- | 9 | 0.42 | 6 | 0.42 | 14 | 0.41 |
| **Total** | **99** | **1.17** | **99** | **1.36** | **99** | **0.99** |

# Preliminary results of potential impact on revenue

**Potential impact by production and commercial specialization**

| Étiquettes de lignes | Demo | worst | Action |
|---|---|---|---|
| *Producers/ Expediters 2* | 0.650 | 0.759 | 0.562 |
| *Producers/ Expediters 1* | 1.185 | 1.367 | 0.990 |
| *Simple Producers* | 1.260 | 1.484 | 1.105 |
| **Total général** | **1.166** | **1.358** | **0.993** |

**… many other criteria can be explored**

## Discussion

-Vulnerability is another way of assessing impacts

- It focuses on the individual heterogeneity of structures and behaviors

- It enables the dealing with qualitative and quantitative information (multi-criteria characterization)

- It enables the identification of the more vulnerable population (a way for implementing more efficient and less costly management measures)