

## 1. Coastal area & policy issue

The sea area of Chalastra is located NW of the inner Thermaikos Gulf. The city of Thessaloniki is at the NE side of the area and the estuaries of Axios-Loudias-Aliakmonas Rivers are at the NW. The surface of the sea area where the mussel farms are located is approximately 1.350.000 m<sup>2</sup>, with minimum depth of 4m and maximum of 20m. Approximately 55 long-line mussel farm establishments and more than 250 pole mussel farm establishments are located in the area. At the land boundary of the system multiple cultivations are located and the channel of the WWTP of western Thessaloniki is located 4,8 km from the area. Due to the systems' water circulation the agricultural run-offs, the output of the WWTP and the estuarine inputs are affecting the area.



The last decade the operation of the WWTP of Thessaloniki altered the nutrient balance in Thermaikos gulf. At the same time, due to institutional and management failures, 60% of the owners of long-line mussel farms are operating illegally: the activity is under no official institutional control, having as a consequence illegal and extreme mussel farming techniques, in order to maximize production and profit. Nevertheless the mussel production is declining annually, causing economical and social pressure to the local community, as the activity is supporting an important percentage of the population. The Policy Issue is the "Sustainable management of the mussel farming activity".

## 2. Approach & design

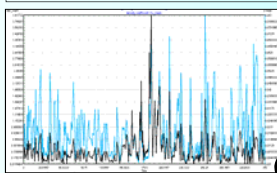
- Individual interviewing of policy makers and major stakeholders in order to gain system knowledge and identify social interconnections.
- Identification of data needs & availability.
- Realising the narrow availability, effort was made to approach the issue simply but addressing matters of great importance for the stakeholders.
- Achieved that by representing the farming procedure in an individually farm level.
- Major goal was to present in a quantitative and efficient way several management points under discussion during the last years as the cultivation techniques, Harmful Algal Bloom occurrence and legislation failures.
- Realising that SPICOSA would be just an initial opportunity, effort was made to stimulate the stakeholders interest in the use of integrated methodologies for the coastal management of the area.

The highest hierarchical level of the model demonstrates the three major components: ecological (inorganic nitrogen, phytoplankton, circulation patterns), mussel farming area (incorporating both the ecology & economy of the mussel farm) and social (management & "social welfare"). The three components can be managed individually, enabling the development or the alteration of each one, if required.

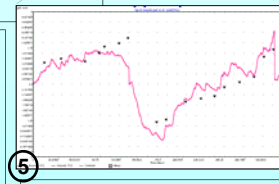
The social component is an on/off switch for the management "enforcement" & an accumulator of the profits.

Both the ecological and the economical component of the mussel farm provide user friendly choice panels, where someone can choose farming characteristics and cost parameters, thus testing different management scenarios.

The "mussel farming area" component is comprised from 5 sub-components, demonstrating sub-areas of mussel farming and a reference area, for comparison purposes.

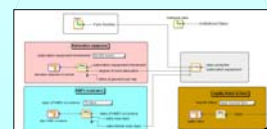


Mussel growth is depended on a) the availability of food (phytoplankton & TOC), b) the environmental conditions (temperature & circulation) and c) the farm characteristics influencing the density of the farm.



The mussel growth sub-model produces values that are presenting satisfying adaption to the filed data collected from the mussel farming sub-areas. The figure shows the observed values of mussels at the mussel farm representing sample stations M1 compared to the values produced by the model.

The "density coefficient" is related both to the farm characteristics & to the water velocity in the area, thus comparing the required water velocity for the feeding of the mussels to the current one. As shown in the figure, this coefficient is most of the times >1.



The economical sub-model is contacting a Cost-Benefit analysis for the individual mussel farm. The profits are then aggregated to produce a prospect for the amount of money entering the local community, as an indicator of the "social welfare".

## 4. Scenarios & results

### 1. Mussel farm unit level management

How and how much is the productivity of an individual long-line mussel farm unit affected from the layout and the characteristics of the farm?

### 2. Mussel farm area level management

How and how much is the productivity of the whole long-line mussel farming area is affected from the characteristics of the units?

### 3. Legal framework and social prosperity

In which way is the economical robustness and retributive benefits of the local community going to be affected from the maintenance and from the improvement of the present legal framework?

### 4. Environmental constraints and mussel farm unit economy

How much are the costs of a unit being affected from the increase of the days where environmental constraints are imposed in the area (days of HAB's occurrence)?

Area management	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4
Number of lines	13	15	12	14
Line distance (m)	8	7	9	8
Sock distance (m)	0.4	0.6	0.4	0.5
Sock length (m)	3.5	4.5	3.0	3.5
Mussel dry weight (kg/m of sock)	11.9	14.5	11.9	13.8
Total production (tn)	89.1	107.4	70.7	89.5
Individual profit (€)	10,300.00	16,500.00	3,900.00	9,900.00

The distance between cultivation socks & the length of the sock are parameters influencing critically the production of a mussel farm.

The weight of mussels/m of sock is considered as a growth and quality index as the number of individuals/m is averagely the same.

The profit of the illegal establishments is approximately 40% less than the legal ones. Every year, up to 300.000 euros are escaping the local economy for the payment of legality fines.

Severe HAB events can cause up to 31% profit reduction.

Area management	Sub-area 1	Sub-area 2	Sub-area 3	Sub-area 4
Number of lines	10	10	10	10
Line distance (m)	10	10	10	10
Sock distance (m)	0.5	0.5	0.5	0.5
Sock length (m)	3.0	3.5	4.0	4.5
Mussel dry weight (kg/m of sock)	18.1	17.6	16.9	18.5
Total production (tn)	71.7	81.6	89.4	110.4
Individual profit (€)	5,525.00	8,900.00	12,000.00	19,200.00

## 5. Stakeholders deliberations & conclusions

✓The first stakeholders meeting was dedicated in presenting the project, the model and the results of the chosen scenarios. Time was invested in questions and suggestions and a preliminary effort of evaluating the procedure from the stakeholders point of view was made.

✓Objective of the second forum was to contact stakeholder deliberations and to create a "stakeholder working group", i.e. a core team of people, comprising from mussel farmers, local managers and scientists, that will meet in a regular bases to discuss problems, policy options and developments of the activity, in order to create a mechanism of direct communication between them.

✓The joint meetings achieved a solid communication base and a public commitment of the highest authorities involved in the activity (Ministry of Energy & Climate Change), creating a strong social impact by raising the hopes for a forthcoming solution, at least for the legal issues.

✓The "stakeholder working group" has contacted it's first meeting discussing i) funding opportunities for the activity and ii) administrative issues of the mussel farmers organization.

✓The policy issue selected has highly political nature and it is driven into a dead-end mainly by the conflicting interests of public and private agents with power to influence the activity, a situation aggravated by overlaps in authority and gaps in legislation.

✓The value of the System Approach Framework (SAF) implementation in the area proved both relevant on an operational and a management level, providing information and enhancing collaboration between institutional and private sector stakeholders.

✓What is now necessary, along with the further development of the management tool, is the reinforcement of the communication base in order to overcome the obstacles created by the general situation.