

# System Design for SSA14 Mar Piccolo of Taranto (Southern Italy)

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## 1. The Policy Issue

### 1.1. Introduction

The Mar Piccolo of Taranto is located North of the town of Taranto and has a surface area of 20.72 km<sup>2</sup>. It is a nearly-enclosed estuary that exchanges through two small inlet channels to a larger semi-enclosed bay (Mar Grande), which opens into the Gulf of Taranto that, in turn exchanges with the Ionian Sea to the southeast and indirectly with the coastal current exiting from the Adriatic (Fig. 1). Mar Piccolo is roughly divided between two basins, defined by an intruding promontory, which are referred to as First and Second Inlet and which have a maximum depth of 13 and 10 m, respectively. The estuarine circulation is driven by an average freshening by a diffuse input of freshwater runoff of approximately 1,620,000 m<sup>3</sup> d<sup>-1</sup>. The estuarine flushing through the inlet channels is generally weak and varies seasonally depending on the density difference with the Mar Grande. Most of the water input derives from 34 submarine freshwater springs (locally called "Citri") and the discharge from small tributary streams that carry agricultural chemicals. In addition, there is the combined discharge of 14 sewage pipes coming from the northern area of Taranto and from 8 nearby towns. These discharges account for about 18,272 m<sup>3</sup> d<sup>-1</sup> (of which 85% at the Second Inlet), with organic matter equal to 6,767 kg d<sup>-1</sup> of BOD<sub>5</sub>. During summer season a relatively strong stratification develops that induces hypoxia in the lower layer. Wind-mixing is low due to the limited fetch and tidal-mixing is also low due to the limited tidal range of ~ 30-40 cm.



Fig. 1. Map of the Mar Piccolo of Taranto (Southern Italy)

Mar Piccolo is strongly impacted by an intensive mussel commercial fishery, a fishing fleet, the largest Italian naval base, and the activities of a large heavy-industrial site adjacent to the west. The heavy industry and navy docks are two of the main employers at Taranto. The steel industry strongly influences the environmental quality of water and sediments, not only through the emissions into the atmosphere but also through the water-uptake for system cooling. The presence of such industrial activities is also in conflict with other productive installations such as the mussel farms and related activities. The drainage of agricultural soils and the sewage inputs are also important factors that influence the water and sediment quality. Mar Piccolo is one of the Sites of National Interest for the highly polluted areas. Under this initiative a specific programme has just started in order to plan an intervention for cleaning sediments and reducing pollution. Regional Programmes also include interventions for the characterization and recovery of surrounding sites that may indirectly influence the quality of the basin.

Policy changes characterized the city of Taranto in the last years. Particularly, the heavy industry (stainless-steel, oil refinery, cement manufacture) started to be established in Taranto some fifty years ago (second half of the 1950s) completely changing the economy of the city and Province that were essentially based on agriculture, aquaculture, navy docks and handicrafts. During this period the population of Taranto grew to over 280,000 inhabitants from 150,000. Severe social problems have arisen recently, especially when the steel industry, which had hired more than 22,000 employees, reduced its employee force to the present level of 8,000. These problems have strongly influenced the quality of life and safety in the city.

## 1.2. The Policy Issue

Taranto has always been one of the most important mussel farming areas in our country. In particular, fishing, distribution, catering, tourism, transport, import and export are activities directly connected to aquaculture that inevitably bring to an economic improvement and therefore a greater social welfare. However some externalities, such as social problems or illegal aquaculture plants that over-exploit the existing natural resources, are causing damage to the ecosystem trophic chain. The establishing of regulating services, which are improved by economic methods, such as market price, cost benefit, benefit transfer, bring to an improvement in aquaculture.

From an economic perspective, cultivation and consumption of mussels, obviously need to be safe. The need to meet health standards requires adopting cultivation methods and depuration procedures in a purified and controlled habitat that ensure both mussel and environment quality. There are some risk factors involved in this type of production. These risks are price competition, quality, quantity and safety of the product that can cause a downfall in social economic welfare because of the aquaculture decline.

We have contacted and met various stakeholders, all involved in mussel culture: the Municipality, the Province, the Apulian Regional Agency for the Environment, the local Universities, the Harbour Office, the Harbour Authority, the Health Office.

All these stakeholders considered that in the last years data from the local market evidenced a drastic quantity reduction of the harvested mussels. Also the taste of the collected mussels isn't so good as the past. Variables such as biochemical composition of the Mar Piccolo mussels might be useful to evaluate their quality. For these reasons, during these meetings researchers and stakeholders have mutually accepted to consider the dysfunctional impact for the Mar Piccolo SSA as **"The reduction of the productivity and the quality of the mussel culture"**. In this consultation process, we agreed with the stakeholders on some policy considerations to include in our Simulation.

### 1.3. The stakeholder partners

The stakeholder partners have been identified as follows:

- Regional Environmental Agency of Apulia Region (ARPA Puglia)
- Province of Taranto (Productive Department )
- Province of Taranto (Environmental Department)
- Province of Taranto (Tourism Department)
- Municipality of Taranto (Ecological and Environmental Department)
- Municipality of Taranto (Productive Activities)
- Municipality of Taranto (Culture and Tourism Department)
- Health Board in Taranto (ASL TA)
- Harbour Board in Taranto
- Harbour Office
- Chamber of Commerce (handicraft and agriculture)
- Industrial Handcraft and Agricultural board of trade
- Heavy industry Representatives: oil refinery - Eni Spa  
stainless-steel industry - ILVA Spa
- Environmental Associations : “Amm. Michelagnoli” Foundation ONLUS ;  
“Verdi”, Political Organization
- Mussel farmers representatives (OPTIMA srl)
- Local Universities representatives (Universities of Taranto and Bari)

The Participant Group is represented by :

1. Regional Environmental Agency of Apulia Region - ARPA Puglia - Prof Giorgio Assennato
2. Province of Taranto (Productive Department ) – Dr Luca Conserva
3. Province of Taranto (Environmental Department) – Dr Giuseppe Stasolla
4. Municipality of Taranto (Ecological and Environmental Department) – Dr Bruno Pastore
5. Municipality of Taranto (Productive Activities) – Dr Rossella Fischetti

The Enduser Group, which comprises all those want to be informed of the Mar Piccolo Activities progress, is represented by all the other organizations.

The meeting reports are available and, particularly, as regards the second meeting, it has been published on the SPICOSA website (Newsletter N. 2). We you are intending to continue working out the scenarios and our approach with the Participant group will be to involve them in many aspects of the SAF procedure, by using all the information derived by their activities in the socio-economic and political context of the mussel culture in Taranto.

### 1.4. HAs and ecological dysfunctions

Concerning the Policy issue: “What are the sustainable policy options for improving the productivity and quality of the mussel culture in the Mar Piccolo of Taranto (Northern Ionian Sea, Southern Italy)?”, the main HAs and Ecological Dysfunctions for the Mar Piccolo in Taranto are reported in Table 1.

Human Activities	Ecological dysfunction	Key Variables linking Forcing to Impact	Impacts on ecosystem goods and services
Mussel culture	Reduction of the mussel productivity and health	mussel recruitment, employment, local jobs	Reduction of the local market, loss of jobs
Urbanization	Eutrophication effects	anoxia, benthic habitat, diversity loss, toxic and harmful algal blooms	Change of trophic structure
Heavy industry	Biochemical pollution	Heavy metals, PAHs, PCBs	Contaminated mussels, stress on organisms
Agriculture	Eutrophication and toxic substances	fertilizer use, field drainage, crops, pesticide use, surface water transport	Same as urbanization, ground-water contamination, ammonia emissions
Navy docks, large ship traffic	Physical habitat destruction	shoreline development, resuspension from large ship traffic	Reduction of mussels recruitment, perceived environmental quality
Transport	Diversity loss and invasive species	bacteria, phyto- and zooplankton, phyto- and zoobenthos, necton	Perceived environmental quality, water transparency

Table 1. List of the main HAs, Ecological Dysfunctions and Impact for Mar Piccolo in Taranto.

### 1.5. Ecological, Economic & Social indicators

**Ecological Indicators:** nitrogen and phosphorus loads, phytoplankton biomass (chlorophyll a) and cell abundance, phytoplankton structure, number of algal blooms, potentially toxic microalgae, chemical pollution, ecological status of water bodies.

**Economic Indicators:**

Mussel culture: Firms, Prices, Incomes, Costs, Supply and demand, Employment, Import-export, Distribution channel

Tourism: Firms, Touristic flows, Resources use (water, waste)

Transportation sector: Firms, vessels, flows

Industrial activities: Firms, employment per sub-sector

Agriculture: Firms, Soil use, Irrigation, Crops, agri-chemicals and fertilizers.

**Social Indicators:** population (population density, buildings density, dense crowd index), employment (n° of employed and unemployed per occupation sector), activity sectors (employees and operators in agriculture, manufactures and services), agriculture (crops, agri-chemicals and fertilizers), education (educational qualification), sanity (mortality tax,

pathologies by environmental risk), quality life level.

The Stakeholder group agreed with us on this set of initial scenarios and in future meetings we will agree on definitive scenarios and their indicators.

## **1.6. Management aims and options**

The major aim of the SSA simulation is to provide decision-making information on policy options to improve the quantity and quality of mussel culture in Mar Piccolo. A set of questions can outline the necessary approach: How do different stakeholders perceive water quality? What are their demands with respect to water quality? Would a “good” water quality (according to the Water Framework Directive) satisfy all stakeholders? Can a “good” water quality be reached in such impacted basin? If no, what would be the alternatives? What are the sustainable policy options for reducing the reduction of the productivity and quality of the mussels? How can this be done to the best long-term interest of the end-users and preserve the bio-productivity of the Mar Piccolo? What trade-offs and options would minimize such policy decisions?

Many problems will be considered to face the following items:

- Initial indifference stakeholders
- Lack of data on the Internet
- Presence data not updated
- Provincial data more than municipal
- High presence of the underground economy
- High presence of illegal cultivation of mussels

Besides the different problems encountered related to the mussel culture in Taranto, stakeholders showed a great participation to solve these questions and, as just reported (1.2 paragraph), in the consultation process with them, we agreed with stakeholders on some policy considerations to include in our Simulation and some scenarios will be used as the basis for the scientific study of the SPICOSA project. These scenarios are:

- What are the sustainable policy options for improving the productivity and quality of the mussel culture in the Mar Piccolo of Taranto (Northern Ionian Sea, Southern Italy)?"
- How can this be done to the best long-term interest of the endusers and preserve the bio-productivity of the Mar Piccolo?
- What trade-offs and options would minimize such policy decisions?

In the next meeting we will refine, add, and rescale these scenarios, and possibly reach an agreement on some of these or other scenarios. To reach this agreement will be also useful present a simplified model which simulate the socio-economic aspects related to the chosen policy issue.

## **1.7. Stakeholder concerns**

During the second meeting for a more in-depth discussion, the ecological implications and the socio-political and the economic aspects were explained and the main “issue” was identified: the improvement of both the production and the quality of the mussels in the Mar Piccolo.

All the participants agreed upon the importance of the selected “issue” for the whole Taranto community. After a long and well moderated discussion, they showed their willingness for sharing all the useful data which they own and declared their pledge for the identification and the realization of all the possible ameliorative policies able to improve the production and the quality of the Mar Piccolo mussels.

The organization of both meetings required a noticeable effort by all the involved staff. But, it was compensated by the high participation and the apparent interest of the most important authorities and institutions. Indeed, in a town such as Taranto, suffering for a strong economic and recent institutional crisis, this result exceeded all expectations.

## 2. The CZ 'System'

### 2.1. Map the System

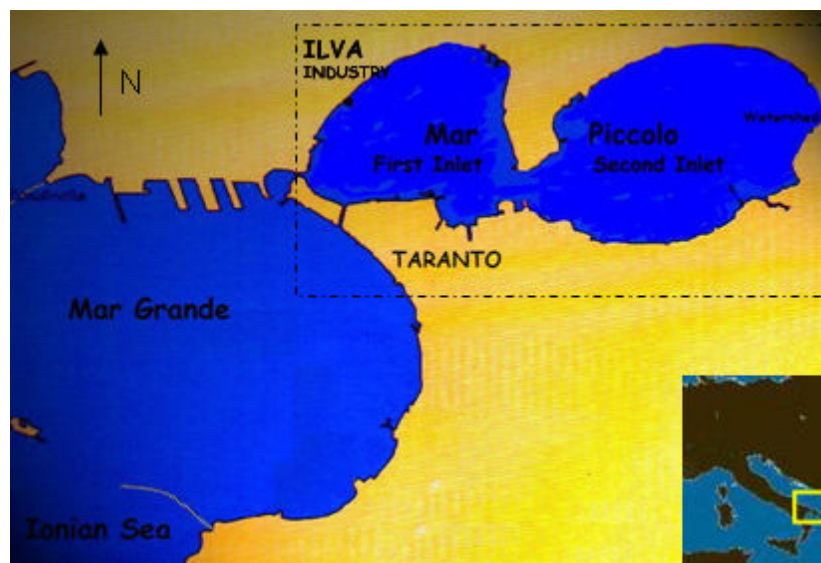


Fig. 2 – Map of the CS: Mar Piccolo and Mar Grande of Taranto

The Mar Piccolo map (Fig. 1) has been drawn with both ecological (submarine springs, small rivers, sewage pipes, industry water-intake machine) and socio-economical (musselculture and aquaculture plans, Navy docks, shipping, heavy industry) features. Also the real boundaries have been evidenced, by separating Mar Piccolo from Mar Grande. The presence of a watershed in the Eastern side of the basin, is more evident in the CS map (Fig. 2). The more dynamic details of vertical structure and bio-composition are depicted in the Odum diagram (Fig. 4).

### 2.2. Ecosystem components and interactions

See the ESE conceptual model (Fig. 4), a more detailed socio-economic conceptual model (Fig. 5) and the list of components, processes and variables of the CS (Tab. 1).

Components	Processes	Variables
Phytoplankton	Light transmission	PAR, TSM
	Uptake	N, P, Si
	Vertical mixing	Wind, Depth
	Stratification	T,S
	Grazing	Zooplankton, Mussels
	Mortality	Virus & Bacteria, Natural
	Sinking	Cell size and morphology
	Encystment	Number of cysts, envir. conditions (time,temp, bottom stress)
	succession	functional groups,
	growth	photosynthesis, chlorophyll

	Respiration	metabolic rate
Zooplankton	Grazing Predation Filtration Mortality Behavior Hatching succession Excretion	Phytoplankton size & density Higher trophic levels Mussels Bacteria, Natural Vertical migration, Life cycles Eggs functional groups fecal pellets
Bacteria	production remineralization degradation competition synergism	C C,nutrients DOC phytoplankton phytoplankton
Sediment interface	resuspension sedimentation remineralization Encystement denitrification benthic production	bottom stress, physical input output from sediments nutrients, oxygen Number of cysts, enviro conditions (time,Temp, bottstress temperature, redox, oxygen species, PAR, oxygen, temperature, nutrients
Mussels	filter feeding hypoxic stress life cycle growth mortality excretion population distribution temperature harvest	POM, size, DOM, larvae, filtration rate oxycline, DObot shell length, Condition Index, temperature feeding natural, anoxia, starvation POM overcrowding, resources limitation physical inputs net catch per year discards income market price variable cost fix cost average variable cost average fix cost profit labour (No of full time workers) effort (total labour cost per year) effort per unit of catch
Oxygen	temperature vertical mixing atmospheric input respiration photosynthesis depth distribution	physical inputs physical inputs air temp, O saturation, water temp T, metabolic rate of biota photosynthetic quotient oxycline
TSM	sedimentation resuspension primary production  external sources turbulence flocculation transport	turbulence, particle size, bottom stress bottom stress, physical input phytoplankton input discharge, river runoff, drainage canals, inorganic fraction physical input bonding forces, particle type circulation
Inputs	Sunlight	Irradiance

	Nutrient loading	Nutrients
	Atmospheric	Wind,
	Atmospheric	Ta
	Atmospheric	RH
	Atmospheric	Pr
	Atmospheric	Cld
	Atmospheric	Natm
	Mixed layer depth	h
	Water inputs	runoff
Human Demography	Waste Production Drains of Purification Plant	Population Density, Building Density, Dense Crowd Index, Educational Level Population jointed to plant
Human Activities	Agriculture Industry  Transports	Crops, agri-chemicals and fertilizers Employees and operators Water drains Annual Traffic
Sanity	Pathologies by Environmental Pollution	Tumors and breathing apparatus diseases
Quality Life	Quality Life Level	Services, Environment and Health
Public Perception	Local Economy	Mussels consumption

**Table 2 - List of Components, processes and variables of the CS**

### 2.3. Transboundary exchanges of materials and energy

See the conceptual model (Figs.4 & 5). In particular, water inflow (nearby marine basin, little rivers and submarine freshwater springs), water outflow (to Mar Grande and the water pumped out for industrial use and discharged outside Mar Grande), urban wastes (nutrients and organic matter loads), heavy industry (pollutants), tourism and transports (pollutants) and agriculture (pesticides) are the Primary External Forcings which will be included in the 'virtual' System. Furthermore, the main processes and variables of the CS will be considered (See Tab. 1).

### 2.4. Internal inputs or withdrawals of materials and energy

Mussel-culture (organic matter), Navy docks (pollutants), the fishing fleet and resuspended matter from ship traffic are the Primary Internal Forcings which will be included in the 'virtual' System. (See Table 2)

### 2.5. The economic dimensions of the CZ system

Table 3 shows the main ecosystem goods and services, together with groups of people that benefit from them and the methods that will be used to assess the financial value of the goods.

Goods	Physical service	Intangible service	Economic Method	Group of People
Dimension and dynamics of stock	Provision of habitat	Food security	Sector analysis	Firms
Safety and quality	Purified and controlled product	Product of quality	Willingness to pay Cost Benefit	Consumer

**Table 3 – The economic dimension of the CS**

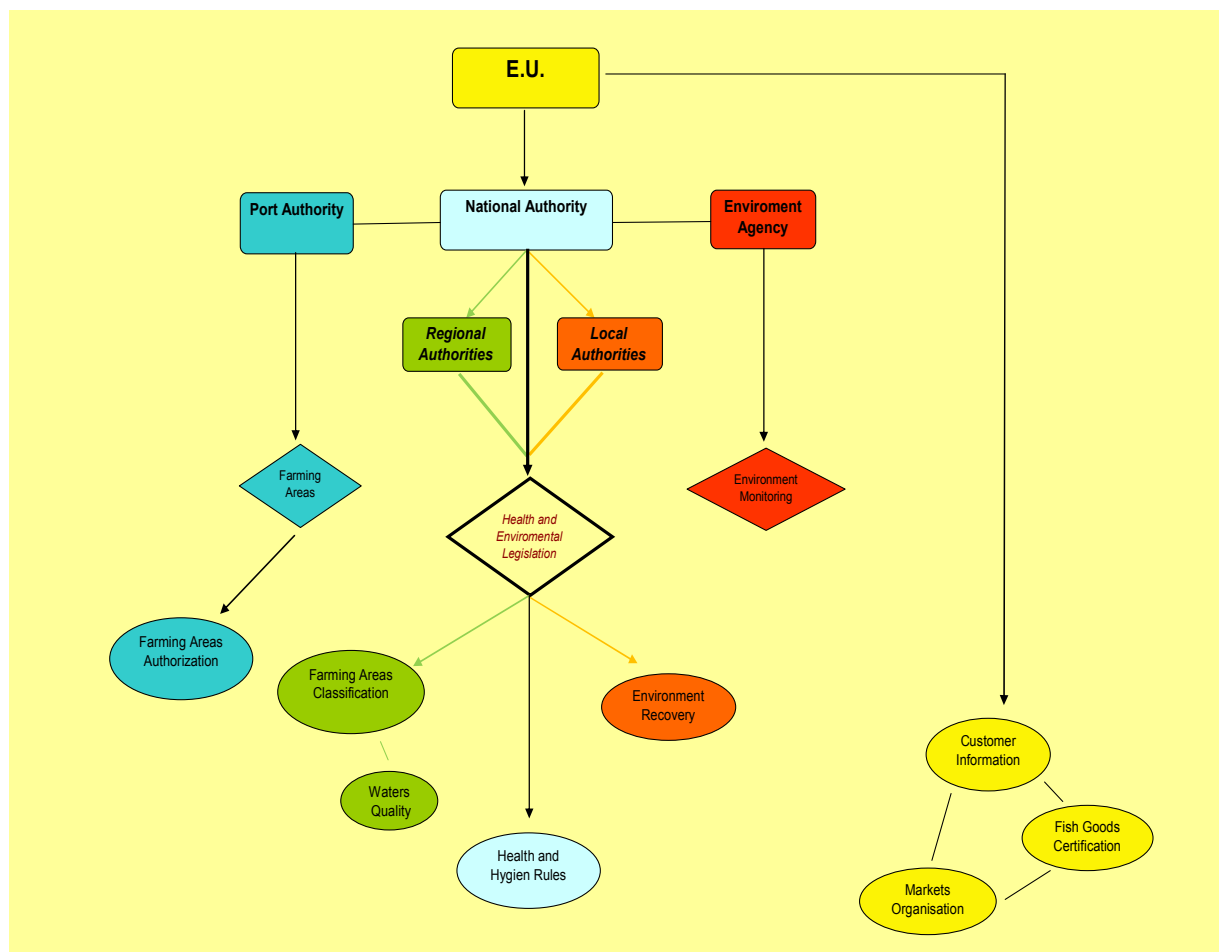


## 2.6. Governance

Legislative Decree n. 530, of 30/12/1992	Up-to-date text of Legislative Decree 30/12/1992 n. 530, that explicates "implementation of Directive 91/4912/CEE that establishes the sanitary laws that enforces to the production and the marketing of the living shellfishes "
Ministerial Decree of 31/07/1995	Methods for the determination of fecal colyforms of Escherichia coli, of the salmonellas, of the seewides bitoxines PSP (Paralytic Shellfish Poison), of the toxins DSP (Diarretic Shellfish Poison), of the mercury and of the chems
Circulars of Sanity Department n. 703/3164/1647 of 20/03/1996	Classification of the production and stabulation shellfishes zones according to DL 30/12/1992 n. 530, and following modifications and integrations
Legislative Decree n. 249 of 15/03/1996	Modifications according to legislative decree 30/12/1992 n. 530 that implements the directive 91/492/CEE that establishes sanitary laws for the production and the marketing of the living shellfishes
Decree of President of Regional Committee n. 343 of 25/07/1996	Legoislative decree 30/12/1992 n. 530 and following modifications - Sanitary higienic laws for the production, the marketing and the selling of the living shellfishes- Decree of implementation
Circulars of Sanity Department - Department of Food, Nutrition and Public Veterinary Sanity. Office IX n. 600.9/3183/4338 of 04/11/1997	Acknowledgement of qualification of the shipment and depuration centers of the living shellfishes
Note of Sanity Department. Veterinary Sanity Direction n. 600.9/31.85/1248 of 09/04/1998	Legislative Decree 30/12/1992 n. 530, sanitary vigilance of the depuration plants
Decree of Republic President n. 395 of 20/10/1998	Regulation that explicates laws of implementation of the directive 95/70/CE about minimum measure against some illnesses of shellfishes
Regional Committee Resolution n. 785 of 24/06/1999	Legislative Decree n. 131 of 27/01/1992- implementation of the directive 79/923 CEE about the quality of the water for the shellfishcolture - Verification of conformity about which art. 3.
Regional Committee Resolution n. 786 of 24/06/1999	Legislative Decree n. 530 of 30/12/1992 art. 4 (Classification procedure of water zones for the production and stabulation of shellfishes). Ratification new classification
Order of Taranto Port Authority n. 226 of 04/10/1999	Zones unsuitables for the picking and the stabulation of shellfishes and for the others activity of fishing
Circulars of Sanity Department - Department of Food, Nutrition and Public Veterinary Sanity. Office IX n. 600.9/3164/2042 del 08/08/1999	Legislative Decree 30/12/1992 n. 530, transfer of the living shellfishes from farming wherein is prohibited the picking for the existence of seewides bitoxines
EC Regulation n. 104/2000 of Council of 17/12/1999	About the common market organization in the sector of the fishing and aquaculture products
Order harbour of Taranto N. 13, of 16/01/2001	Regulations for the request and the granting of state maritime areas for shellfish in Taranto
EC Regulation N. 178/2002, 28/01/2002	What sets out the general principles and requirements of food law, establishing the European Food Safety Authority and laying down procedures in matters of food safety
EC Regulation 2065/2001, of 22/10/2001	What establishes the procedure for implementing EC Regulation n.104/2000 Council regarding consumer information in the field of fisheries and aquaculture products
EC Regulation 221/2002 of Commission 6/02/2002	Modifying EC Regulation 466/2001 setting maximum levels for certain contaminants in food
Ministerial Decree 27/03/2002	Labelling of fish products and control system
EC Regulation 852/2004 of the European Parliament and Council of 29/04/2004	Hygiene of Foodstuffs

EC Regulation 853/2004 of 29/04/2004	What sets specific rules on hygiene for food of animal origin
EC Regulation 854/2004 of the European Parliament of Council 29/04/2004	What establishes specific rules for the organisation of official controls on products of animal origin for human consumption
Order harbour of Taranto N. 107 of 11/04/2005	Identification of areas anchor of Mar Piccolo and Mar Grande of Taranto
Proposal for a Directive of the European Parliament and Council of 12.05.2006 COM (2006) 205 final	Relative to the requirements for the quality of shellfish waters
Council Directive of 24/10/2006	Relative animal health conditions applicable to species of aquaculture animals and products thereof, and the prevention of certain diseases in aquatic animals and control measures against these diseases
Decision of the Commission of 06/11/2006	Modifying decisions 2003/804/EC and 2003/858/EC as regards the conditions of certification applicable to the living and shellfish live fish aquaculture and related products, intended for Human consumption
EC Regulation n. 834/2007 of Council of 28/06/2007	Its organic production and labelling of organic products and repealing Regulation (EEC) N. 2092/91

**Table 4 – List of laws regulating the mussel culture in Italy and in Taranto seas in particular**



**Fig. 3 – Institutional map**

## 2.7. CATWOE

Stakeholder groups	Categories	Features
Faculty of Mathematics, Physical and Natural Sciences - Department of Environmental Sciences-	<b>C: Customers</b>	Groups representing the conscience of society, who takes care of the respect to seascape, through the research and process of making aware.
Zoology Department	C	
Michelagnoli Foundation - <i>Valorisation, development and research</i>	C	
"Verdi" Association	C	
NGOs non government organisation - Non-party political pressure groups, advisory agencies, aid agencies and consultancies that list among their aims the protection of the	C	
ENI S.p.a. - Oil refinery - Security, Health and Environment Department	<b>A: Actors</b>	The different categories of environmental pressure groups.
ILVA S.p.a. - Environment and Ecology Department	A	Multinational companies and some pressure groups
OPTIMA s.c. - Aquaculture and Fishing organisation	A	are protagonist of impacts to seascape
Controller of agricultural food chain	A	
Regional Environmental Protection Agency - A.R.P.A. Puglia	<b>O: Owners</b>	Pressure groups organisers such as Local Authorities and
Environmental Local Authority - Taranto Province	O	Agency for catches monitoring
Production Activity Local Authority - Taranto Province	O	
Tourism Local Authority - Taranto Province	O	
Fishing front-office - Production Activity Local Authority - Taranto Province	O	
Ecology and Environment Local Authority - Taranto Municipality	O	
Production Activity Local Authority - Taranto Municipality	O	
Tourism Local Authority - Taranto Municipality	O	
Local Health Service - A.S.L. Taranto - Prevention Provincial Department	O	
Port Authorities	O	
Chamber of Commerce (handicraft and agriculture)	O	
Transformation	T	Improvement of the mussels productivity and quality
Weltanschung	W	Mussel farming plays an important role in the economy of the Taranto city.
Environment	E	Farming technology, regulatory laws.

Table 5 – CATWOE

## 2.8. Other social dimensions of the CZ system

Environmental problems are often a sum total of individuals' actions, so **each person may have to change their attitude to ensure a solution**. Working with local people can inform environmental managers of the threats, limits and opportunities they may otherwise have missed. Sustainable development strategies need to be designed to fit local conditions and to be co-ordinated to ensure that one locality or stakeholder groups should seek to develop integrative and mutually supportive strategies.

Consequently, the stakeholders involved in environmental efforts for a sustainable development should be **“players”, “bystanders” and all have interest in the environment. The participants should be individuals, groups, institutions, organisations**. It is relevant to conduct a stakeholder analysis seeking by identifying all the

stakeholders and by establishing who is involved and how the environmental management of the region can harness support and reduce opposition.

In the stakeholder analysis we should try to engage with the right people in appropriate way to achieve results, and to work out their power, interests, capabilities, needs and so on.

We will identify the key groups affecting by or causing environmental change, looking at two voiceless groups that Adams (1990) singled out: **“the blind”** and **“the dumb”**.

**“The blind”** may include consultants, scientists, economists, bankers and those bent on riches or blinkered by concern for national/local security.

**“The dumb”** may include people or institutions who are uninformed for the implications of development, or who are unable adequately to promote their views and affect change.

There is another target audience of our project: **“the unaware”** which may include scientists who fail to perceive the problem or opportunity, not due to prejudice or greed, but because the issue is unfamiliar to them, and/or it happens too slowly to register or too fast and unexpectedly. Our research and monitoring and adaptive managing approaches can help reduce these problems.

In particularly, about Mar Piccolo problems, we have to look at the improvement of environmental stewardship by integrating policy making and participants in environmental management: groups seeking change (NGOs, media, academics,) public, users and controllers.

We will try to involve many people through the use of questionnaires and focus groups: schools, stakeholders, NGOs, etc. The main objectives of these questionnaires will be to evaluate the general perception of the improvement of the mussel production and quality in the context of the Taranto economy. For this reason, questionnaires will be sent to all the stakeholders involved in the SPICOSA project and also proposed to a significant number of people representatives of different cultural and socio-economic context.

It is important warning stakeholders, endusers and people of the threats and identifying opportunities through forum and using the carrying capacity value stretch (CCVS) model incorporated into nominal group technique (NGT) methodology. We will try to investigate the local community’s determinants of socio-cultural carrying capacity perceptions in the wake of sustainable development.

Because the governance is the sum of ways that individuals and institutions, public and private, manage their affair, we will stress with the various local authorities (municipal, provincial and regional) to follow the directions of governance procedure reform of the White Paper, in order to make institutions and policies more transparent, inclusive and accountable. They should be solicited in a different way: through meetings debates, forum, press conferences, etc. These activities have been carried out during the meeting organized in our Institute (IAMC-CNR). We should work at multilevel governance and try to build a network between stakeholders, local people and government.

## 2.9. DPSIR and CZSFL

	ecosystem	socio economic system
<b>D</b>	Mussel farming, heavy industry	Mussel farming, heavy industry
<b>P</b>	Nutrient ratio unbalanced and pollutants discharges	Uses conflict, overexploitation of spaces. Industry externalities
<b>S</b>	Biomass and quality of seston and pollutant concentrations	Socio economic troubles
<b>I</b>	Mussel starvation and reduced healthiness	Market inefficiency, loss of jobs, loss of capital assets
<b>R</b>	Controls on mussel-farming	Policy command and control instrument: carrying capacity evaluation, area selection, discharge controls, license Policy market instrument: Preferential access, subsidies, certification scheme

## 2.10. Risks

	potential risks	work required to estimate level of hazard	work required to estimate probability of occurrence
<b>ecological</b>	pathogens causing the collapse of the resource	literature analysis to identify the list of possible diseases	analysis of previous mussel infections
	contaminants causing the prohibition of mussel consumption	comparing available information on sediment contamination and literature information on mussel uptake	analysis of available models (not in-house)
	decrease of primary production	literature analysis to analyze data on primary production changes and mussel productivity	analysis of available models (not in-house)
	invasive species causing the alteration of trophic chain	literature analysis to identify similar cases in similar ecosystems	analysis of available models (not in-house)
<b>Socio-economic</b>	Decline in the quantity of the mussel production	Literature analysis	Analysis of stock dynamics
	Sale of not safe product	Literature on illness study	Analysis of related illness
	Plants of aquaculture illegal	Analysis of regular and irregular plant in local area	Local unofficial stakeholder estimate

## 2.11. Synthesis

See the conceptual models (Figs. 4 & 5)

### 3. Conceptual Models

#### 3.1. The conceptual model of the ESE System

See the conceptual models (Figs. 3 & 4)

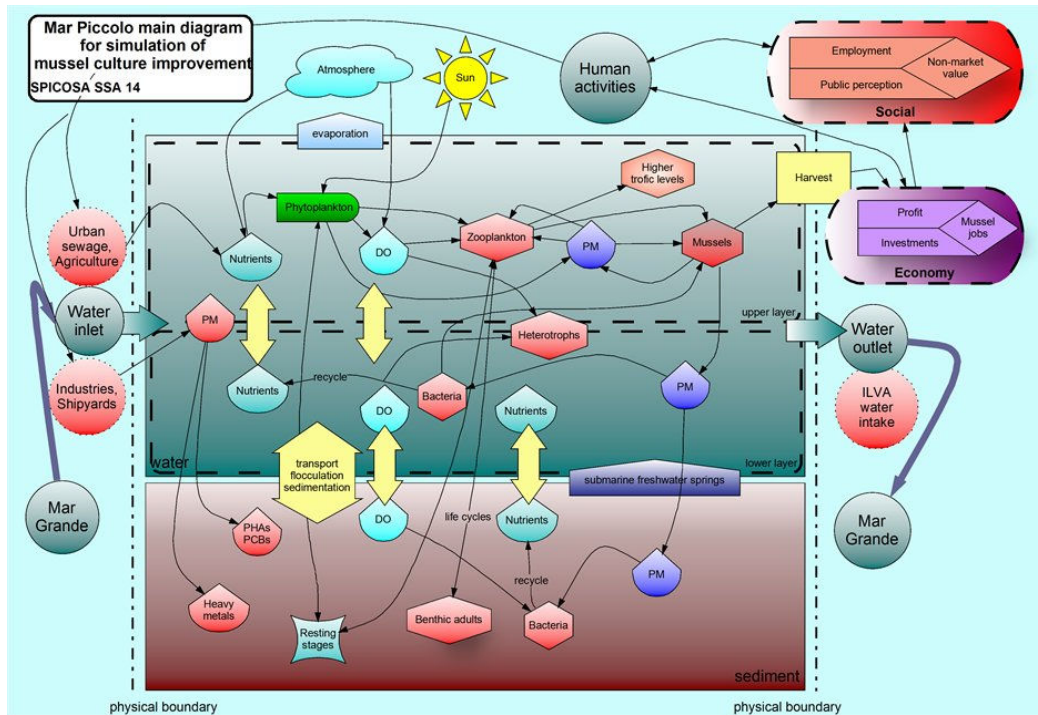


Fig. 4. ESE Conceptual Model

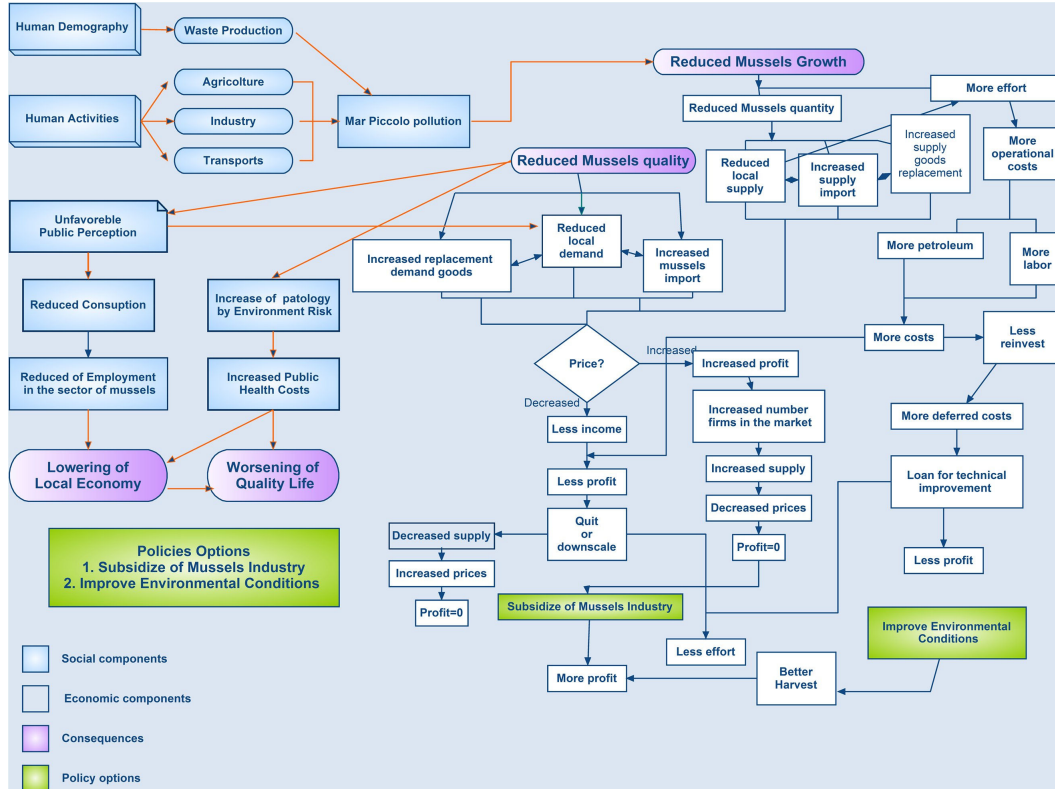


Fig. 5. Socio-Economic Conceptual Model

### **3.2. Time- and space- scales**

Ecological phenomena acting over different temporal scales will be considered. We're evaluating different ways in order to achieve the best outcome. In particular, the time scale will range between 3hrs and 1 day, according to socio-economic and environmental processes. Furthermore, as regards the spatial scale, we'll consider the entire Mar Piccolo as 2 boxes, with the "mussel culture" as a small box within each basin.

## **4. Methods and Information Needed**

### **4.1. Methods for numerical simulation**

Numerical model be constructed using Extend, in addition also EXCEL and other programmes will be used.

### **4.2. Data needed for the numerical simulation**

Sediment and water quality parameters, chemical speciation of contaminants in sediments and in the water column, ecological and meteorological data. All the required data are reported in Table 2.

### **4.3. Data needed to validate model**

All ecological data are available from monitoring plans. Meteorological and economic data come from official sources (e.g. port authorities and ISTAT). See Table 2.

### **4.4. Socio-economic data availability and needs**

#### **Social data**

- Population (Population Density, Building Density, Dense Crowd Index) – Source: Census Section by Municipal Technical and Register Offices
- Employment (N° of employes and unemployes per occupation sector) – Source: Centre of Public Employment
- Activity Sectors (Employed and operators in agriculture, manufactures and services) – Source: ISTAT - industry and agriculture census, Chamber of Commerce
- Agriculture (Crops, agri-chemicals and fertilizers) – Source: Provincial Agricultural Inspectorate of Taranto
- Education (Educational Qualification) – Source: Centre of Public Employment
- Sanity (Mortality Tax, Patology by Environment Risk) – Source: ASL, Jonico-Salentino cancer register
- Quality Life level – Source: Il Sole 24 Ore journal
- Problems Perception about Mar Piccolo – Source: Interviewes to Users

#### **Economic data**

No previous market analyses exist on the economy of Mar Piccolo that are sufficiently updated and wide in perspective. For the peculiarity of the SS it is not possible to fit similar cases from literature.

### **Data to be collected**

- Production, distribution and marketing of mussels – Source: Fishing front office, Production Activity Local Authority, Taranto Province, ISTAT
- Quantity and prices for import/export for mussels – Source: ISTAT
- Income and profits for the companies involved in Taranto mussel culture: – Source: Fishing Front Office, Production Activity Local Authority Taranto Province
- Number of companies involved in Taranto mussel culture – Source: Chamber of Commerce, ISTAT
- Data related to the workforce engaged in the sector – Source: Chamber of Commerce, ISTAT
- Investment data expressed in terms of technologies and respect for the environment – Source: Ecology and Environment local Authority-Taranto Municipality.

## **5. Outputs**

### **5.1. SAF System Design Portfolio**

The main objective of the SPICOSA project for the Mar Piccolo in Taranto is to improve the relationships between politics, stakeholders and researchers. For this kind of experiment, the question which has been chosen is the improving of the mussel culture. This is a very important question, because it will represent an economic activity alternative to the heavy industry which has been responsible for environmental and sanitary problems in Taranto.

To reach this objective many are the problems to consider and possibly solve. In fact, multiple uses of Mar Piccolo imply economic interdependencies and conflicts among different users which make difficult, if not impossible, to adopt management measures in a sustainable perspective. Management of reduced resources strongly risk to make some gainers and many losers if they are not conceived and implemented in a coordinate manner. Public local institutions, local representatives, a short number of very well motivated operators, in mussel sector, and eventually in other sectors, together with the scientific support of IAMC-CNR could create a “network of excellence” using a participative process – on the model of A21L, creating a local consortium, ...-, defining roles, objectives, actions, funding means of promotion and valorisation –EMAS, public procurement, eco-label ...).

This could be evaluated during the project so to produce a sort of feasibility study at the end of the project.

### **5.2. Internal outputs**

VS system design to WP4 and WP5. Output specifications to WP6. Data problems and simulation support data to WP9.



### 5.3. Human resource management

<b>Partner</b>	<b>Used for Design Step person-months</b>	<b>Available (project month 1-18) person-months</b>
Institute for Coastal Marine Environment, CNR	20	21
Stazione Zoologica Anton Dohrn, Naples (ecosystem components)	2	3
Department of Social Sciences, University of Salento (Social components and interfaces with economic and natural components)	4	6
University of Molise; Faculty of Economics (Economic components and interfaces with social and natural components)	4	6

### 5.4. Critique

As discussed in the MEDCLUSTER meeting in Venice with the colleagues of the other SSAs, we encountered problems related to some definitions about both to ecological (e.g. the term “impact”) and socio-economic aspects. Many problems have been clarified in the Chapter 9 of the SAF. Furthermore, as regard the economic point of view, more inputs would be appreciated about the choice of methodologies to be used and, mostly, on how to use them, not from theory but in a practical view.