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Integrating assessment scheme for Mediterranean and Black Sea regions

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People for Ecosystem based Governance in Assessing
Sustainable development of Ocean and coast

Work Package 4

Multi-scale tools, methods and models for integrated assessment

PEGASO Deliverable D4.6

Integrating assessment scheme for Mediterranean and Black Sea regions

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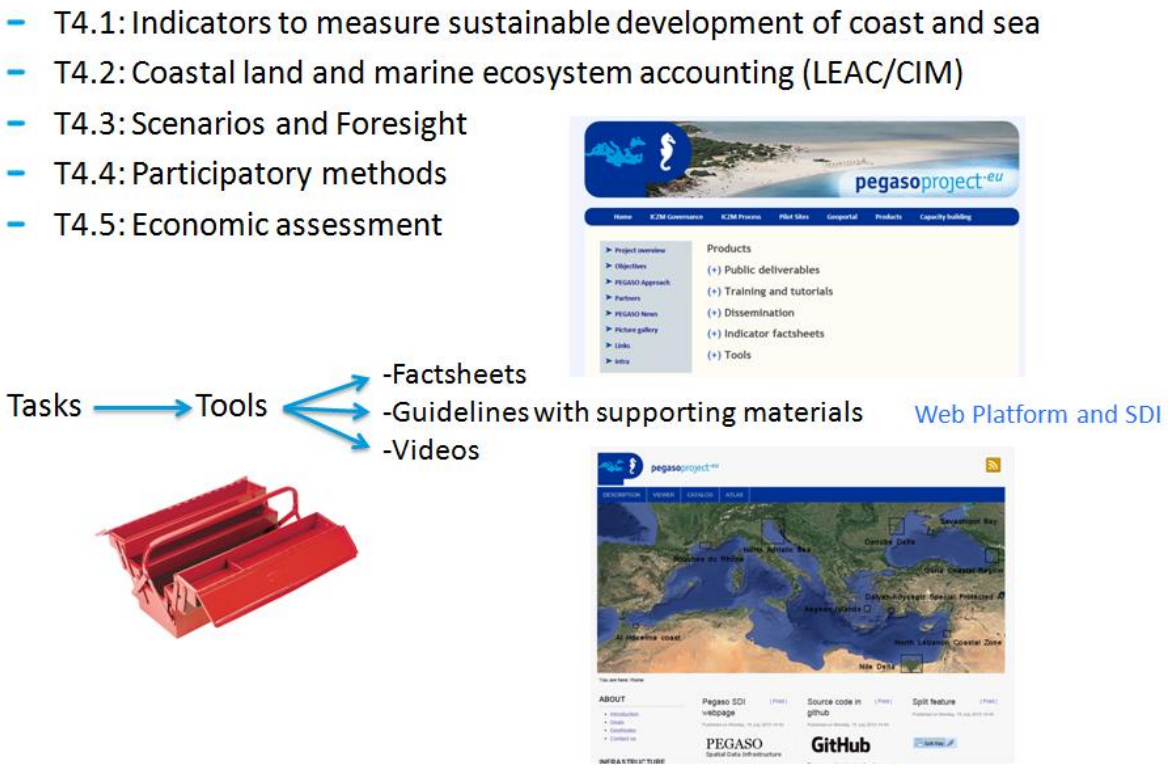
Contents

Introduction

The objective of WP4 was to exploit and refine existing scientific expertise and methods relating to indicators, environmental accounting, scenario construction, participatory approaches and economic assessment, to create a suite of tools and techniques that can be used to make a multi-scale assessment in the coastal zone in the Mediterranean and Black Sea Basins. The integration of this series of tools was thought through a common analytical framework that can form the technical and methodological basis of the assessment platform for ICZM. A series of tools were then developed, devoted to the implementation of integrated assessment in support to ICZM (Figure 1).

Figure 1 The PEGASO toolbox



The task of making an integrated assessment for the coastal zone cuts across a number of science, policy areas and economic sectors. As a result, those engaged in such assessments have to take account of a range of different types of information. Present knowledge and techniques are fragmented and difficult to accesses and apply. For robust and credible assessments to be made, a bridge has to be established among sciences and between the science and end-user communities so that decision makers can gain access to relevant data, be supported in the interpretations they make, able to transform these data into information that effectively supports the judgments they make.

The aim is to building on and refine existing scientific achievements and to create a suite of tools and techniques that can be used to make a multi-scale assessment across the region. These tools will ultimately support end-users in their future work. No single approach can be prescribed and users must be able to combine the results of applying the various tools according to the specifics needs of

the task they face. Thus WP4 provides a flexible suite of tools that can be used in different problem contexts and cop with the issue of fragmented knowledge and information resources.

The work in each task was shaped and informed by an interactive process of development and testing with end-users both at the regional scale and at the scale of study sites (CASES). A set of initial prototype tools and analytical outputs be tested and developed during the life-time of the project was provided through a series of guidelines along with supporting materials (illustrations, videos, factsheets). The proposed tools are the following:

- Indicator construction
- Coastal land and marine ecosystem accounting (LEAC and SEAC/CIM)
- Scenarios and visioning tools
- Participatory processes and methods
- Economic assessment

In addition to the factsheets produced for the above tools, additional ones were also produced for none selected tools (transfer values…) and second layer of tools (technical or complementary tools useful for the implementation of PEGASO tools such as: Multicriteria Analysis, Input/Output, Institutional Mapping…).

The testing and development work was also part of the capacity building process embedded in PEGASO through several training sessions. Deliverables have been designed to feedback the PEGASO SDI portal[1] (Figure 1).

Where we have indicators, LEAC and scenarios, the link between them should be highlighted to identify added value. Therefore integrating economic assessment on these methods should provide new hints. Finally, working on these tools in a participatory context should also bring facilities and added values for the project results and for a better implementation on site by decision makers. This is the logic that drives the present deliverable and draws the proposed integrated assessment framework informed and supported by PEGASO tools.

The choice of an integrated assessment scheme as a way to provide the initial and so called "Toolbox" relies in a double statement: an ex-post integration and a rather lower effort devoted to the task in terms of resources compared to the tools development.

To assess the best way to combine tools in an integrated approach, a review of what could / should be a toolbox through Decision Support Tool is first implemented. It is then reframed in the context of ICZM and integrated assessment before proposing an integrated assessment scheme. Finally, limits of the approach, issues for future assessments, developments and way forward to sustain the PEGASO platform are discussed.

[1] http://pegasosdi.uab.es/geoportal/

1. How assessment tools could/should be structured to contribute to inform and support decision

1.1 Support to decision making

An initial review of tools and the way they contribute to decision making through Decision Support Tools (DST) in the field of ICZM (Le Gentil et al. 2009) enlightens how tools are structured and built.

Decision support tools are usually made of data base linked to simulators in a common architecture in order to produce synthetic information and facilitate the understanding of complex processes. It's a relationship between data, belief and decision process (Canessa et al. 2007). Following data collection and production, information is the result of data processing and analysis that results into knowledge, e.g. a general and common understanding of issues. At last, beliefs which are the results of this process strengthen the ability to decide. In addition to knowledge, another dimension can be added to the decision making: the assessment (Boulanger and Bréchet 2005). To take a decision it is necessary to identify the different potential actions regarding the problem to be addressed, to choose criteria allowing measuring their efficiency, to assess alternative scenarios based on these criteria, to rank the planned scenarios according to their utility and last to choose the best solution or reinitiate the process.

In the field of sustainable development, decision making is of specific interest due to three main reasons. First, objectives are not known in advance as their definition is part of the decision making process. Then it doesn't exist one decision maker but several and all of them have distinct references and referential (interests, beliefs, etc.). Finally, the costs and benefits assessment is far more difficult than for other issues due to externalities (time based, spatial and social), uncertainties and nature/society interactions. Each of these characteristics calls for a specific methodology in the field of support to decision making.

Time externalities require a long term approach (over several generations). Spatial externalities lead to think at both local and global scales (interactions). Social externalities make use of participative approaches essential. The numerous existing uncertainties require their consideration in the management process and Nature/Society interactions make multidisciplinary approaches mandatory.

Decision making tools construction in support to ICZM is less documented in terms of publications and experiences do not address all the above characteristics. Decision support tools are more generally translated through visioning or foresight analysis. This is however reducing as all tools do not belong to modeling approaches and do not use evolution scenarios.

One of the decision support tools mostly used is the thematic atlas, a symbolic tool of planning, still used in matter of territorial management. Most of them have turned into numerical and online atlas allowing for information screening at requested scale.

Sustainability indicators are more and more present in such atlas operating over the coastal zone, confirming the impact of the Internet in terms of dissemination of available knowledge. Such process is illustrated by Canessa et al. (2007) in terms of stocking, consultation and analysis of spatial data in support to ICZM in Canada over the last 30 years: from atlas in the 70-80's to Information Systems in

the 80-90's and then to Geonodes in the 90-2000's. In the last case (Geonodes) it also underlines that the simultaneous use of technologies such as GIS, Internet and electronic networks facilitate cooperation between stakeholders or end-users.

These approaches mainly refer to dissemination of synthetic information from the coastal zone to a wide public in order to support the implementation of participative processes. Rather than supporting decision, their aim is to produce knowledge and inform and as such are generalist approaches where most of issues related to coastal are addressed.

1.2 Problems oriented approaches

Aside information systems, there are more analytical tools often turned towards solving specific problems. It's often based on their outputs that information systems as knowledge disseminating tools exist.

As such, they comply more to the two requirements of decision making: knowledge and assessment. GIS are certainly the most well-known because of the output mapping of data processing. Opposite to common belief, they are not mapping software but spatial analysis tools allowing the production of new information by crossing existing information. GIS is defined as a coherent set of hardware, software management and analysis, databases and human resources.

In the field of ICZM there are a number of examples of GIS implementation (Gourmelon et al., 2006): support to monitoring coastal changes, coastal planning and MPAs, monitoring and analysis of coastal risks. But GIS' contribution is however limited by their static nature, making their coupling with dynamic models essential such as Individual Based Modeling allowing to describe human activities in space and time and to test various scenarios trend or event in coastal areas. Such tool is then able, on the basis of available data, to consider potential conflicts uses or to assess the level of activities impacted by the occurrence of pollutant event in a given point.

Beyond of decision support tools producing spatial information, there are other approaches such as stakeholders' games (Schouten et al. 2001). For instance, multi-actor information systems were developed in order to prevent conflict uses by identifying interests, beliefs, incentives and influences of different stakeholders. Others are probabilistic techniques or macro-economic approaches.

2. Integrated assessment and information system

2.1 Needs for integrated assessment

The quality of aquatic environments and the attached biodiversity are one of the main axes of environmental policies, both for land and marine/coastal areas. Policies about water management (Water Framework Directive), Nature conservation (Habitats Directive, Birds Directive, Natura 2000) and marine area (Marine Strategy Framework Directive) highlight the concepts of integrated management and ecosystem based management. Issues are multiple and arise in terms of sources of anthropogenic pressures, of impacts over the environment or human activities, and in terms of public policies (DPSIR scheme). These are in part issues related to the maintenance of ecosystem services essential to support a number of activities, market and non-market, particularly in the areas of water quality and biological productivity. Other relates to the preservation of the support functions that affect biological diversity without necessarily and directly affect human activities. For all these aspects, public policies' objectives and regulatory requirements are becoming more stringent, while statements of continued deterioration seem more frequent than the reversal of trends. To difficulties related to increasing and combining effects of anthropogenic pressures, are added changes in ecosystems due to climate change.

The implementation of public policies faces many difficulties. Interactions between natural processes (physical, chemical and biological) and social processes (institutional sociological, economical) involved are complex and often poorly understood. In addition, strategies for environmental management cannot be reduced to the search for technical solutions. It is much more likely to negotiate rules in arbitrating between competing interests and build the legitimacy of public choice. Both in the field of knowledge and governance, current systems are too compartmentalized and do not respond effectively to the challenges raised by these environmental issues. This partitioning applies to economic sectors together as well as civil society, administrative areas, scientific disciplines or consultancy. Causes and social and economic consequences of environmental quality and biodiversity degradation are numerous and increasingly become a major issue for the territorial development and its attractiveness. The need for an integrated approach mobilizing knowledge from expertise and experience is increasingly felt. The diversity of powers between States and the various levels of local governments, the lack of participatory process, and transdisciplinary research poorly valued, are among factors that do not facilitate the implementation of integrated approaches, especially when addressing the land-sea continuum and watersheds.

To that purpose, PEGASO attempts to develop a methodology and tools for mobilizing and integrating knowledge about environment, uses and governance that meets decision makers and managers needs supporting by expertise and existing information systems (indicators, LEAC, participation, scenarios).

2.2 Building local information system

Integrated assessment "means assembling, summarizing, organizing, interpreting, and possibly reconciling pieces of existing knowledge, and communicating them so that they are relevant and helpful to an intelligent but inexpert decision-maker" (Parson, 1995). Local information system is an interesting tool to reach this objective. Indicators must give understandable information about complex systems in order to be useful for decision-making processes and to support strategic planning processes. The indicator system requires the following properties: few indicators, qualitative and quantitative indicators, trends and movements must be captured; special indicators must be selected to represent the characteristics of the specific coastal area (Hong et al., 2006). Indicator's spatial units must also correspond so far as possible to user practices, management schemes and/or ecosystemic scales. Indicators system is then used to rebuild existing statistical information at the scale of natural resources management in order to produce another map of the local economy and associated pressures (Le Gentil et al., 2011; Raux et al., 2013). It aims to get a measure at the scale of the issues, according to potential environmental management/governance units. One the major difficulty is to resolve conflict between socio-economic and geographic precision. Detailed economic and social data are often available for national and regional scales but miss at the local level. So existing databases, scientific and grey literature and collect complementary information with local stakeholders have to be used simultaneously in order to produce a correct and useful picture of drivers, pressures and associated degradations at the desired scale. Finally, indicators deal with multiple criteria by nature (like social reality) and their building process is a continuous way. Indicators system must be completed when emerging issues are detected in the study area.

2.3 Integrated assessment in the context of the ICZM protocol for the Mediterranean

PEGASO approach is multi issues in support to the implementation of the ICZM protocol in the Mediterranean and needs to the Black Sea. This protocol defines ICZM as *"a dynamic process for the sustainable management and use of coastal zones, taking into account at the same time the fragility of coastal ecosystems and landscapes, the diversity of activities and uses, their interactions, the maritime orientation of certain activities and uses and their impact on both the marine and land parts"* (article 2, ICZM Protocol).

This implies to take into account the interrelationships that exist between coastal and marine uses and the environment they potentially affect. To address environmental and social issues relying on these interrelationships, PEGASO proposes an integrated information system based on existing information, mainly through indicators. The new information is the integration of existing ones. In the ICZM context, the objective is to mobilize and bring a reliable and understandable information useful to the public decision. This should feed the deliberation process and support the Sciences and Policy integration.

Building an information system at appropriate scales to feed and support the deliberation and decision making process is challenging. Coastal systems are complex: socio-ecosystems demonstrate

non-matching scales, non-linearities, interconnections with other systems, memory effects, choke points...

In a context of intensification of uses on coastal and marine areas leading to conflict uses and increasing pressures and impacts, the aim is to identify main environmental issues and their links under a simplified Pressure Impact framework. It will form the crucible to build indicators to inform the integrated assessment of coastal and marine areas through uses and pressures. The DPSIR scheme is a popular approach for ICZM; it appears as useful to describe a coastal system, a causality chain in relation to a sustainability management problem.

It is also important to underline that there are no ICZM tools but tools contributing to and supporting the ICZM process. ICZM is not a discipline with specific tools but a process. Misunderstanding ICZM as an object[2] and not a process led to a series of misunderstandings and failures in implementing ICZM. This is especially the case in terms of infrastructures devoted to ICZM, giving the illusion of a technical issue, when it has much more to deal with the Science and Policy integration (integration within sciences and integration between sciences and policy, sometimes solely called science policy interface). The new knowledge is the integration of existing knowledge. Tools developed in support to ICZM are tools that should help inserting into that process. ICZM is at the core of the governance of coastal socio-ecosystems and is a way of governance.

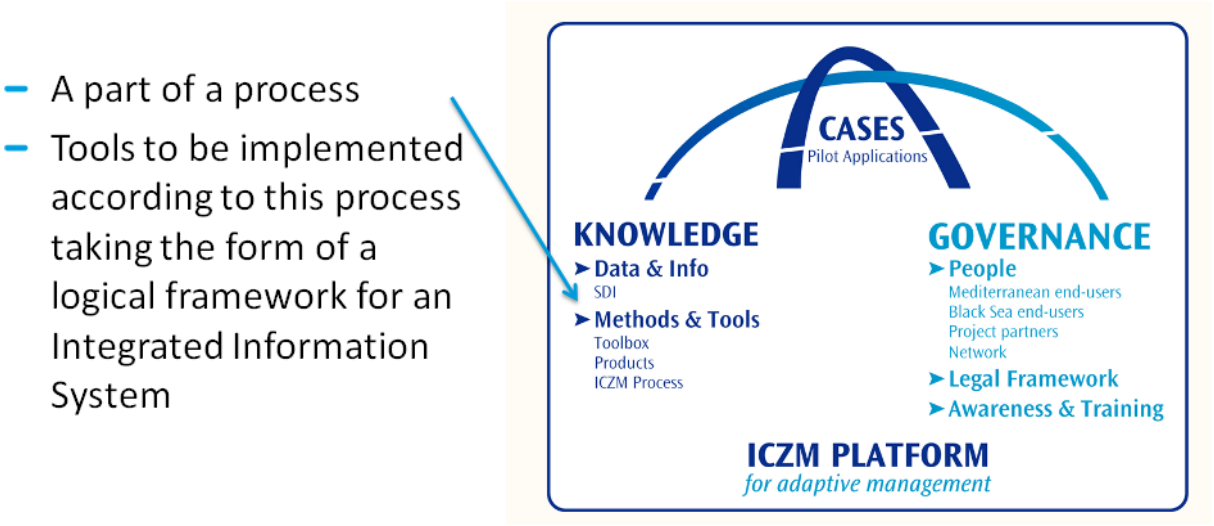
2.4 Terms of reference for the integrated assessment scheme and proposal of an integrated information system fed by PEGASO's tools

The integration of assessment tools developed within the PEGASO project attempts to highlight the link between tools to identify added value. Integrating economic assessment on these methods provides new hints and a better implementation on site by decision makers. An integrated assessment framework informed and supported by PEGASO tools is then proposed, together with a step by step approach to facilitate its implementation. Each tasks developed tools and supporting materials to form a toolbox available under the SDI and the project Website (Figures 1 and 2).

Compilation or integration of tools do not making an integrated assessment, an integrated information system fed by PEGASO's tools is proposed to act as a coherent integrated assessment framework (Figure 2).

[2] Here as a technical object; but ICZM can be considered as a research object.

Figure 2 Rationale of the PEGASO integrated assessment scheme



Following the review of roots, demand and needs for integrated assessment for coastal and marine socio-ecosystems in the context of the ICZM protocol, the integrated information system can then defined according to some reference terms:

- In the ICZM context, mobilize and bring a reliable and understandable information useful to the public decision.
- No new information but integrating existing ones: the new knowledge is the integration of existing knowledge.
- It should feed the deliberation process and not substitute to it.
- Tools are coming in support to ICZM and should help inserting into that process. There are no ICZM tools but tools contributing to the ICZM process.

The economic assessment approach developed within PEGASO (Raux et al. 2013) was thought and built beyond of its solely assessment so that it can take place in a wider assessment framework where different tools[3] can be implemented in order to perform assessment of socio-ecosystems according to a chain of actions.

Entitled the Environmental Territorial Diagnosis (ETD), the framework acts as a Local and Regional Information System in support to ICZM through an integrated information system.

[3] PEGASO's tools as well as other existing ones if any available when performing the assessment.

3. Environmental Territorial Diagnosis (ETD) as the proposed integrated assessment scheme

3.1 Definition and objectives of the Environmental Territorial Diagnosis (ETD)

Beyond of the pure economic assessment in terms of valuation, a wider assessment framework has been designed and proposed where different tools can be implemented in order to perform assessment of socio-ecosystems according to a chain of actions. Entitled the Environmental Territorial Diagnosis, the framework will act as a Regional Information System in support to ICZM.

Again, PEGASO approach is multi issues in support to the implementation of the ICZM protocol in the Mediterranean and needs to the Black Sea. In that wide context of integrating issues and operational constraints (budget, knowledge), greening the traditional territorial diagnosis tool appears as appropriated to meet PEGASO's objectives. This tool is called Environmental Territorial Diagnosis (ETD).

The territorial diagnosis is an inventory on a given territory that lists problems, strengths and weaknesses, economic social and ecological issues, taking into account the diversity of stakeholders. It aims at providing explanation on the past evolution and assessment of the future one. It will aim at understanding the territorial system, being here the costal and marine territory. There is no real defined method as territorial diagnosis is not an end in itself but rather a step in a more global approach.

In the already described context of intensification of uses on coastal and marine areas leading to conflict uses and increasing pressures and impacts, greening the territorial diagnosis (the Environmental Territorial Diagnosis) will underline territorial dynamics and environmental issues. The aim of the ETD will be **to identify main environmental issues in a territory and their links with the territorial dynamics** under a Pressure Impact framework.

ETD is not really a tool but rather a framework to implement different tools in a coherent and integrated way. It will form the crucible to build indicators to inform the integrated assessment of coastal and marine waters through uses and pressures. ETD will allow identifying and structuring issues to be addressed; it will first attempt to answer to the following questions:

- **What is the environmental issue?**
- **What is the management issue?**
- **Is there already a local ICZM process to be inserted in?**
- **Are there other institutional initiatives to be taken into account?**
- **What is the social and economic information to mobilize to address environmental issues in coastal zone management?**

3.2 A step by step analysis framework

Issues can be identified and sorted through a matrix crossing issues and institutions/stakeholders together with their related intensity. This has to be done in a participatory way with stakeholders and end-users. Once this preliminary step achieved, the integrated assessment can be performed through the following step by step framework analysis, from appropriation of issues to action:

i) **Identify and inform issues through PEGASO tools and other available ones if already existing (EIA…)**

ii) **Institutional analysis (existing governance scheme, ICZM process…); describing the political and environmental regulations applicable.**

iii) **Outline interactions and interdependencies between activities and environment (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks) by building a causal chain or diagram of influence under a Pressures Impacts framework.**

iv) **Inform and characterize this web of relationships using PEGASO tools (LEAC, CIM, Indicators) to build a shared diagnostic over the area and issues.**

v) **Feed the deliberation process based on the shared diagnostic to explore barriers, opportunities and options for ICZM (scenarios).**

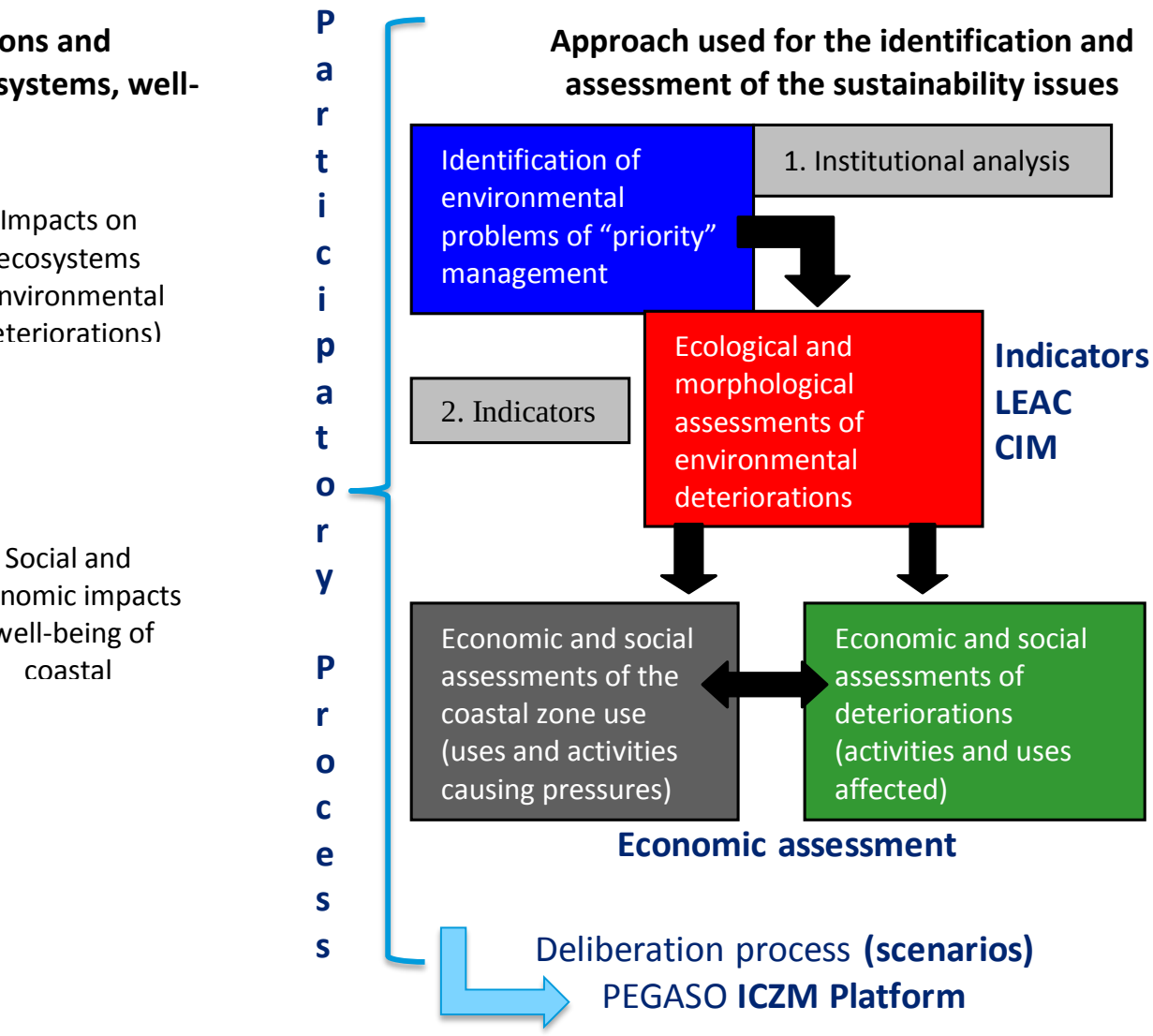
The methodology consists in building regional and local indicator systems, which describe the current situations and could also estimate subsequent changes over time (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks). It aims at providing explanation on the past evolution and assessment of the future one. There's then a need to build new spatial indicators to better analyze interactions between uses, pressures, ecosystem services and well-being of coastal population.

Inform the web of relationships and especially uses can rely on the economic and social importance of different sectors related to coastal and marine environment, by describing the main activities relying on natural resources uses (fisheries, etc.), depending from (tourism, etc.) or having a significant impact on the marine environment (agriculture, industry, etc.). It will analyze the existing links between ecosystem services production and economic welfare and human well-being. It can be ideally completed by an assessment of the cost of environmental degradations and management responses (assessment of degradation costs due to overuse, misuse or mismanagement of marine ecosystems and resources). Several approaches like multi-criteria analysis (MCA) or SWOT analysis can be used to test potential effects of new management scheme implementation.

The approach designed for the integrated assessment will act as a framework where different tools can be implemented in order to perform the integrated assessment of socio-ecosystems according to a chain of actions. Developed under a Pressure/Impact logic, it can be summarized into a 3 dimension mapping informed by indicators (LEAC and CIM outputs being spatialized indicators), Economic assessment and Scenarios (Figure 3) to identify and assess the sustainability issues on the costal socio-ecosystem:

- Institutional mapping, governance scheme and regulations.
- Mapping of physical processes.
- Mapping of economic processes.

Figure 3 Environmental Territorial Diagnosis as the integrated assessment scheme.
A 3 dimensions mapping to identify and assess the sustainability issues on the costal socio-ecosystem.



The deliberation process is also part of the integrated assessment through the information provided as a basis to built scenarios. At the regional level, a key output of PEGASO is the inception and implementation of an ICZM platform. The platform will enable science and end user communities to build a common understanding of issues and institutional perspectives affecting the Mediterranean coastal zone, by sharing data and information, case studies and insights. At local scale, it can be taken advantage from existing forum identified in the institutional analysis or having advantages to create new ones, either formal (the Nile Delta Coastal Group) or informal (PEGASO stakeholders group in other CASES).

Finally the methodology proposed for assessing the degradation cost of marine and coastal ecosystems takes place in a wider integrated framework allowing implementing the series of tools developed for the economic assessment and other complementary PEGASO tools (indicators, scenarios, and participatory methods). This implementation is proposed in a rather logical and step by step approach, each step being complementary and dependent to the other, in order to get a structured framework for the best implementation and use of assessment methods. This framework is designed under the form of an Environmental Territorial Diagnosis (ETD) and will act as the so-called "Tool Box" in order to integrate PEGASO's multi-scale tools, methods and models to perform an integrated assessment.

3.3 Implementation process of the ETD with illustrations

The objective is to identify (i) the key natural resources attached to the territory, (ii) the different functions associated, (iii) main territorial dynamics linked to resources management, (iv) and role of stakeholder in this dynamics and resources management. The approach starting on natural resources is ending on the territory.

Step 1: Identify and inform issues: Issues are identified and sorted through a matrix crossing issues and institutions/stakeholders together with their related intensity. This has to be done in a participatory way with stakeholders and end-users. The following application (Figure 5) was implemented over the Bouches du Rhône CASE. The issue of water quality was identified as the most relevant one to be addressed.

Step 2: Institutional Analysis (existing governance scheme, ICZM process…), describing the political and environmental regulations applicable. Implement an institutional mapping (in a participative and collaborative way) according to issues and related resources. There's a number of existing methods, such as the ones derived from the Soft System Modelling approach. A PEGASO factsheet had been produced to document that step. An innovative and powerful approach is the one developed by Bainbridge et al. (2011) and entitled the Rapid Policy Network Mapping aiming at understanding governance structures for the implementation of marine environmental policy. An illustration over the Black Sea, one of the PEGASO regional application site, is illustrated by Figure 5. A SWOT analysis can also advantageously complete the institutional mapping.

Figure 4 Initial institutional mapping of Black Sea regarding transregional environmental issues (Knudsen 2012, FP7 KnowSeas project).

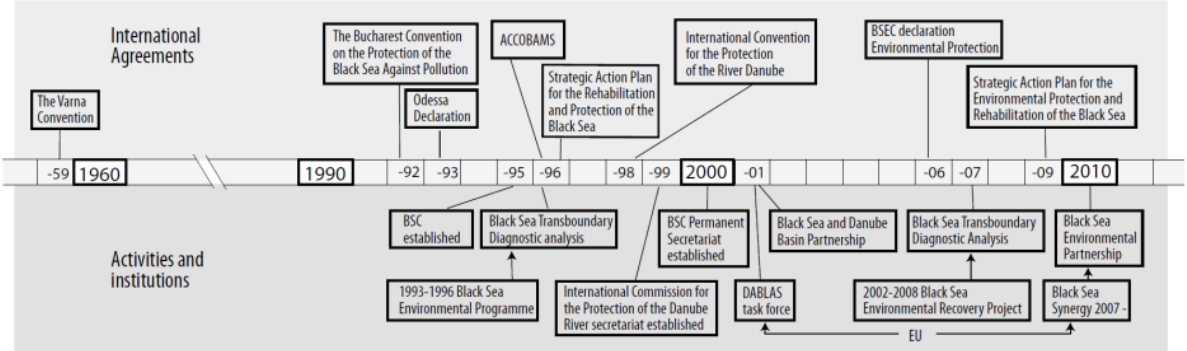


Figure 5 Schematic for the identification and analysis of coastal and marine issues in the Bouches-du-Rhône CASE, France.

Issues underlined by territorial agents

Issues / Structure	Manmade coastal spaces, spaces reclaimed from the sea	Erosion, marine submersion risks	Land transport of hazardous products	Harbour dredging	"Land" contamination of marine waters (a)	"Maritime" contamination of marine waters (b)	Soil contamination (chemical substances)
Direction Inter-Régionale de la Mer Méditerranée	=	=	=	=	=	=	=
Conseil Général des Bouches-du-Rhône	=	X	=	X (Marinas)	X	=	=
Martigues	=	=	X	=	X	=	=
Marseille Provence Métropole	=	=	X	=	X	=	=
Ville de Marseille	X (landscape)	=	=	=	X	=	=
Grand Port Maritime de Marseille	=	=	=	=	=	=	=
Parc Marin de la Côte Bleue	=	=	=	X	X	X	=
Parc Naturel Régional de Camargue	=	X	=	=	X (pesticides and fertilisers)	=	=
GIP Calanques (Parc national des Calanques)	=	=	=	=	X (red mud)	X	X

Issues / Structure	Coastal traffic		Coastal sea traffic	Marine debris	Fishery resource exploitation	Use conflicts (coastal zone)	Wind power (project)
Direction Inter-Régionale de la Mer Méditerranée	–		–	–	–	–	–
Conseil Général des Bouches-du-Rhône	X (free access)	X (PN Calanques)	–	–	–	–	–
Martigues	–		–	–	–	X	–
Marseille Provence Métropole	–		X (Marinas?)	–	–	–	–
Ville de Marseille	–		–	–	X (Fishing, aquaculture)	X	–
Grand Port Maritime de Marseille	X (free access)		–	–	–	–	–
Parc Marin de la Côte Bleue	–		X (marina, diving)	–	X (trawling)	–	X
Parc Naturel Régional de Camargue	X (free access)		–	–	X (illegal fishing)	X	–
GIP Calanques (Parc national des Calanques)	X	X (PN Calanques)	X (Marina)	X	X (professional and no-professional fishing)	–	–

Remarks: (a) Pathogenic micro-organisms, chemical substances, atmospheric fallouts; (b) accidental pollution, operating spills.

Key: Major issues in orange, issues whose importance is not determined yet or minor issues in pale yellow, threats in green

Step 3: Designing a web of relationships. Outline interactions and interdependencies between activities and environment (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks) by building a causal chain or diagram of influence under a Pressures Impacts framework. Inform and characterize this web of relationships using PEGASO tools (LEAC, CIM, Indicators) to build a shared diagnostic over the area and issues.

Gets a characterization of actors' economic weight for each activity weighing over these resources (activities based on direct or indirect uses of site shared resources) at an ecosystemic scale, according to boundaries linked to natural resources uses (river basins, sub-river basins…), to cultural or economic logics, etc.

At least inform and describe the economic and social importance of different sectors related to coastal and marine environment, by describing the main activities relying on natural resources uses (fisheries, etc.), depending from (tourism, etc.) or having a significant impact on the marine environment (agriculture, industry, etc.), using outputs from Indicators, LEAC/SEAC and economic assessment tools.

By rebuilding existing statistical information at the scale of natural resources management, this will produce another map of the local or regional economy to get a measure at the scale of the issues, according to potential environmental management/governance units (for instance river basins impacting coastal and marine areas).

Step 4: synthesis and representation of data: producing spatial results through a common interactive and dynamic interface (to be developed or using existing and suitable software such as GIS or automatic cartography software). Another option is to use economic tables characterizing the issue, uses and resources.

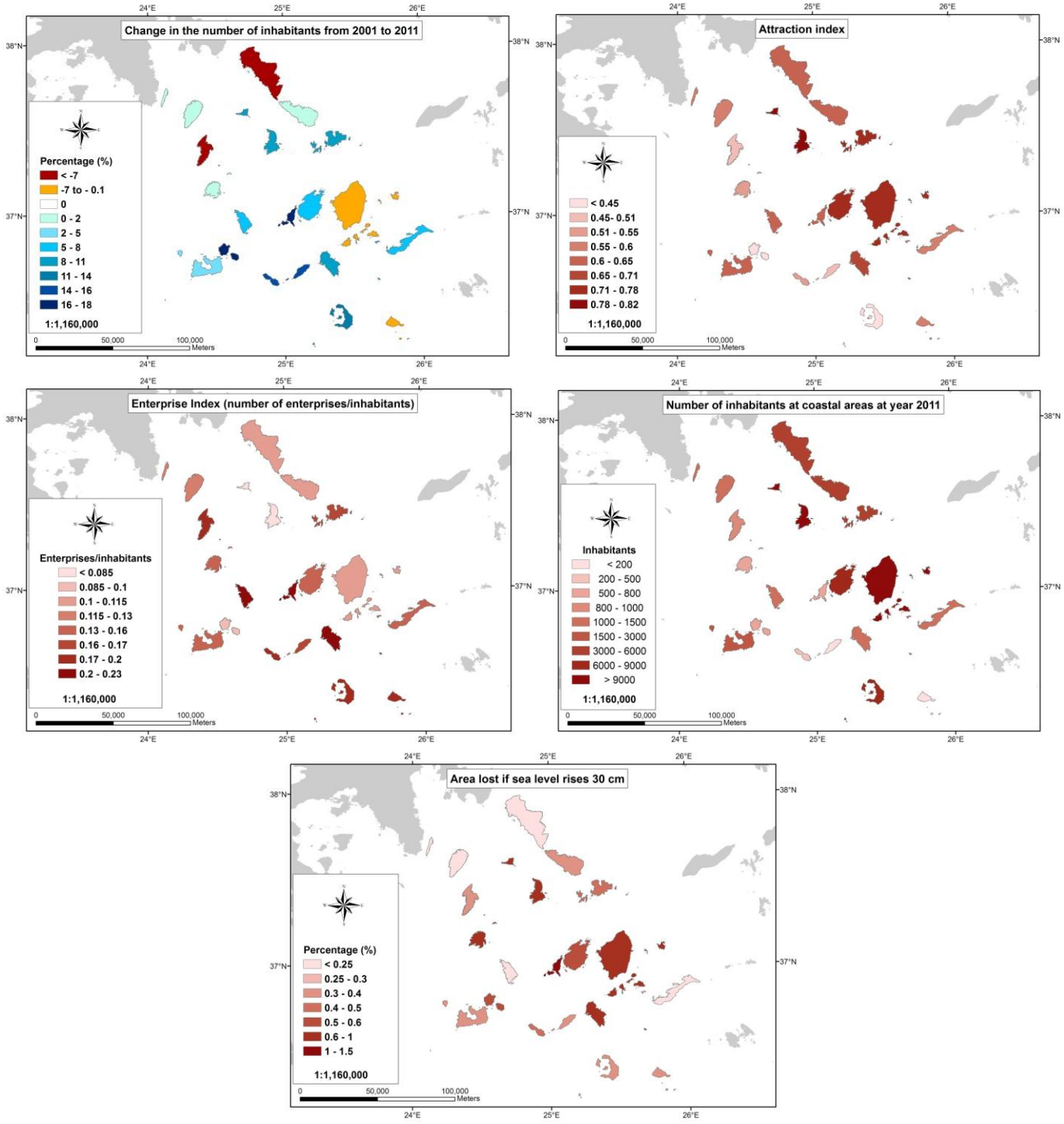
Application at local scale (CASES)

The application of Steps 3 and 4 is an illustration over the Cyclades archipelago, one of the PEGASO's CASEs.

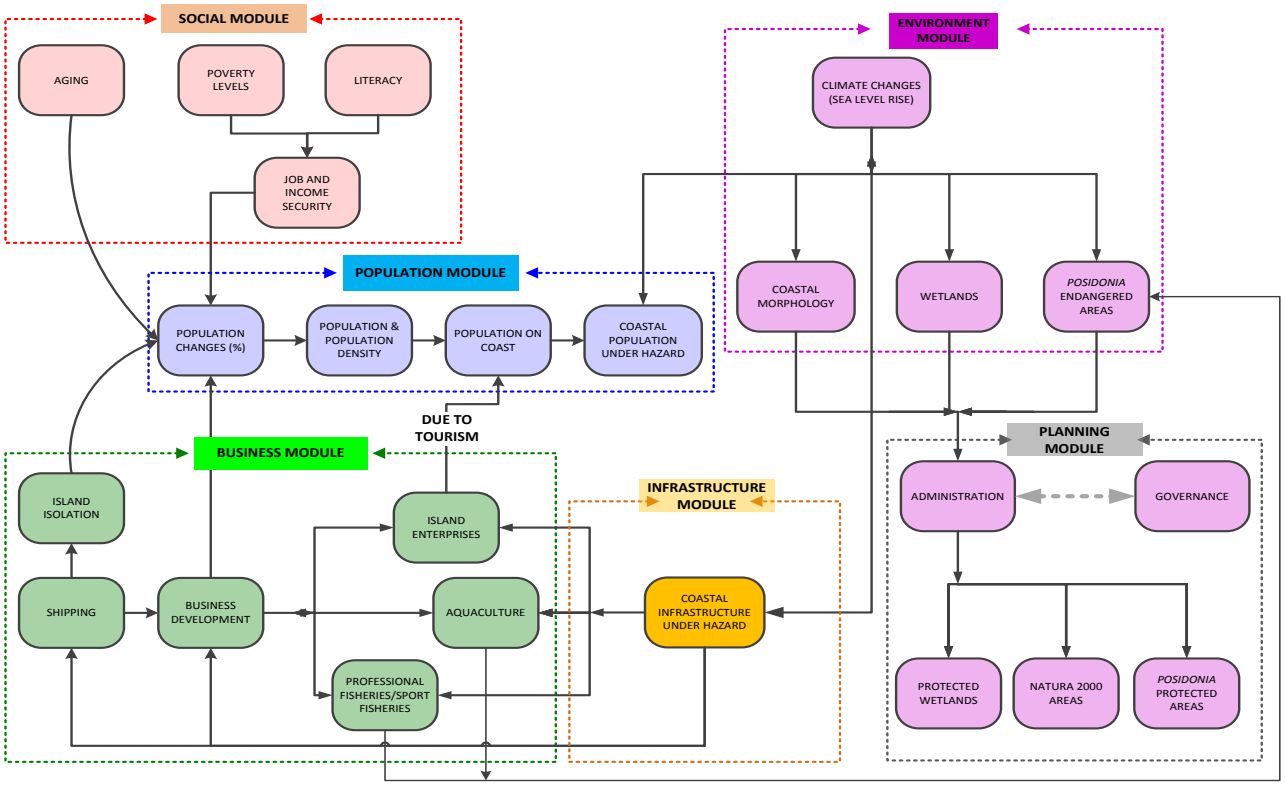
The vision of the ICZM protocol is to achieve a balanced use of the coastal zone so to have both socio-economic development and conservation of Natural Capital. In the Mediterranean, urban development and especially urban sprawl is one of the main threats exerted by socio-economic development. The protocol emphasizes that "allocation of uses throughout the entire coastal zone should be balanced, and unnecessary concentration and urban sprawl should be avoided".

This is well illustrated by the Cyclades archipelago where tourism, the main activity, relies on the attractiveness of the territory mainly based on natural capital. But at the same time it causes a shifting in population between islands due to employment opportunities, a driver to coastal habitation and threats over natural capital. This also leads to an increasing percent of population under risk from climate change (Figure 6).

Figure 6 Maps of indicators to inform ICZM issues over the Cyclades archipelago (Greece)

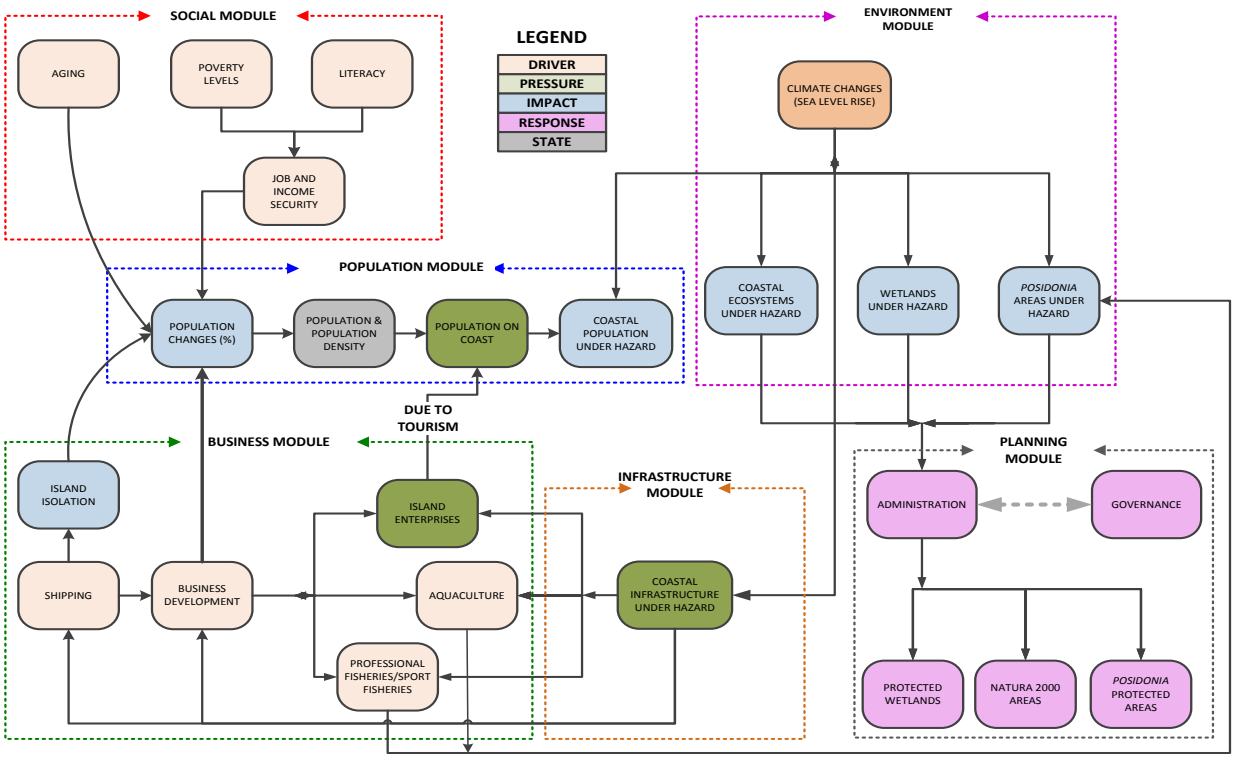


Box 1 Designing a web of relationships – Application over the Cyclades archipelago CASE, Greece



Network of interaction of the Cyclades archipelago (Greece) regarding ICZM protocol's issues

The web of relationships regarding ICZM protocol's issues over the Cyclades archipelago takes the form of a cause-effect network or a network of interactions that allows for outlining interactions and dependencies between activities, the environment and the governance scheme. This diagram of influence was also built under a Pressure / Impact framework. It is also an important tool in informing and involving stakeholders:



Network of interactions of the Cyclades system under a DPSIR framework

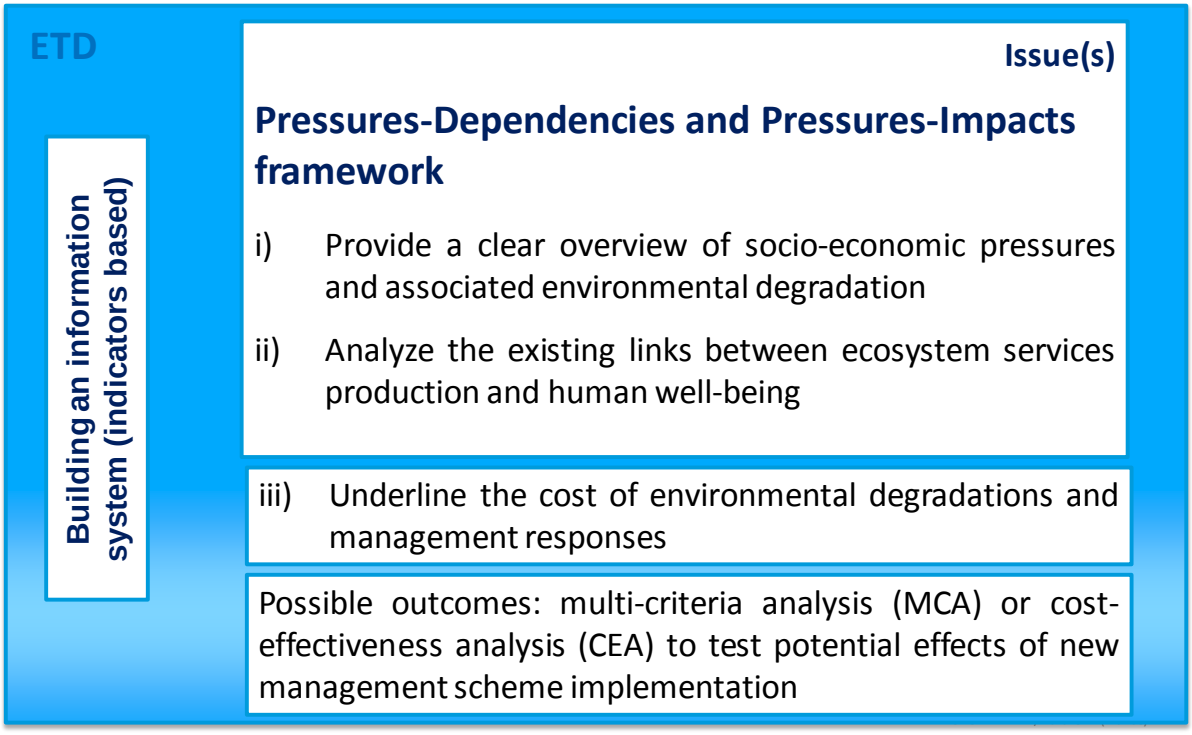
These two sides of the "balanced use" can be decomposed in main categories and their linkages through Pressures-Impacts identified. Then going upstream, it can be looked for drivers of coastal development and then checked for the main categories of responses as feedbacks. Impacts can be considered in terms of changes in ecosystem state or in human wellbeing. This can be informed through a web of relationships between uses and the environment taking the form of a causal chain or diagram of influence (Box 1), characterized by the set of tools developed by PEGASO (indicators, LEAC, Cumulative Impact Mapping, participation, scenarios).

The coastal and maritime economy derived from these uses and enlightened in the Protocol can be defined as marine and coastal activities or activities being impacted or exerted a pressure over the ecosystem. The scale of the assessment requires working at ecosystem level.

Step 5: Underline the cost of environmental degradations and management responses. Possible outcomes: multi-criteria analysis (MCA) or cost-effectiveness analysis (CEA) to test potential effects of new management scheme implementation. This step is illustrated and detailed in the PEGASO Deliverable D4.5 (Raux et al. 2013).

The environmental and territorial diagnosis is made up of several distinct and complementary tasks: an institutional analysis that gives an account of local stakeholders and institutions diversity and their actions for the coastal zone management; a multidisciplinary assessment (morphological, ecological, socio-economic indicators) of priority environmental issues.

The implementation scheme of Environmental Territorial Diagnosis can be finally illustrated as followed:



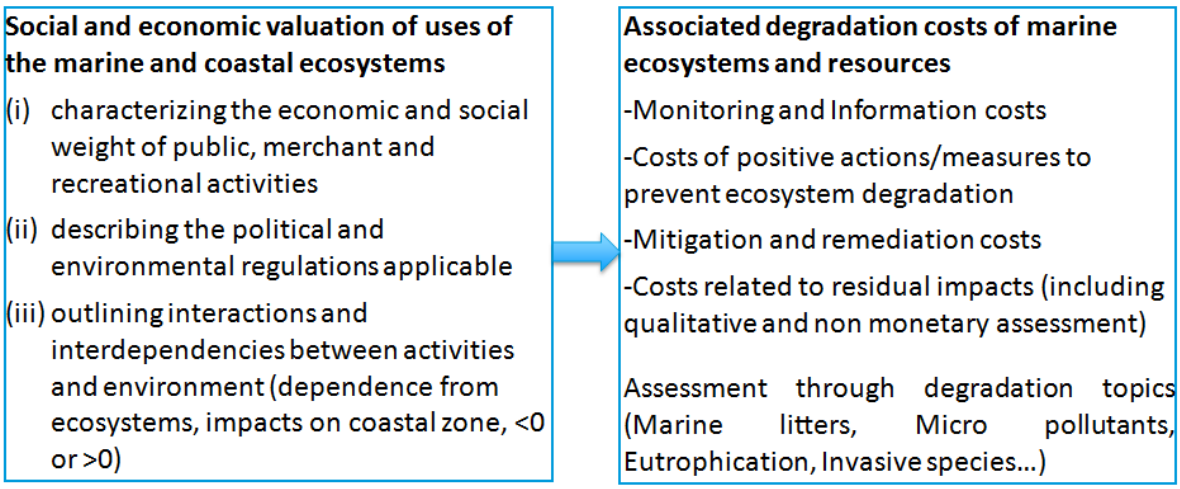
Social and economic valuation of uses of the marine and coastal ecosystems: points i) and ii) of the implementation scheme

In detail it will consist in building local indicator systems, which describe the current situations and could also estimate subsequent changes over time, but also underline dependencies from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks. The related issues can be ideally identified and informed using PEGASO tools (indicators, participatory approaches) and other available ones (EIA…). It is proposed to use the DPSIR framework to facilitate this step. DPSIR a popular approach for ICZM: useful to describe a coastal system, a causality chain in relation to a sustainability management problem.

This allows for characterizing the economic and social weight of public, merchant and recreational activities, as well as outlining interactions and interdependencies between activities and environment (dependence from well-preserved ecosystems, impacts on coastal zone but also positive feedbacks).

This practical process is summarized under the following Figure (Figure 7):

Figure 7 Local information/indicators system for marine and coastal zone assessment



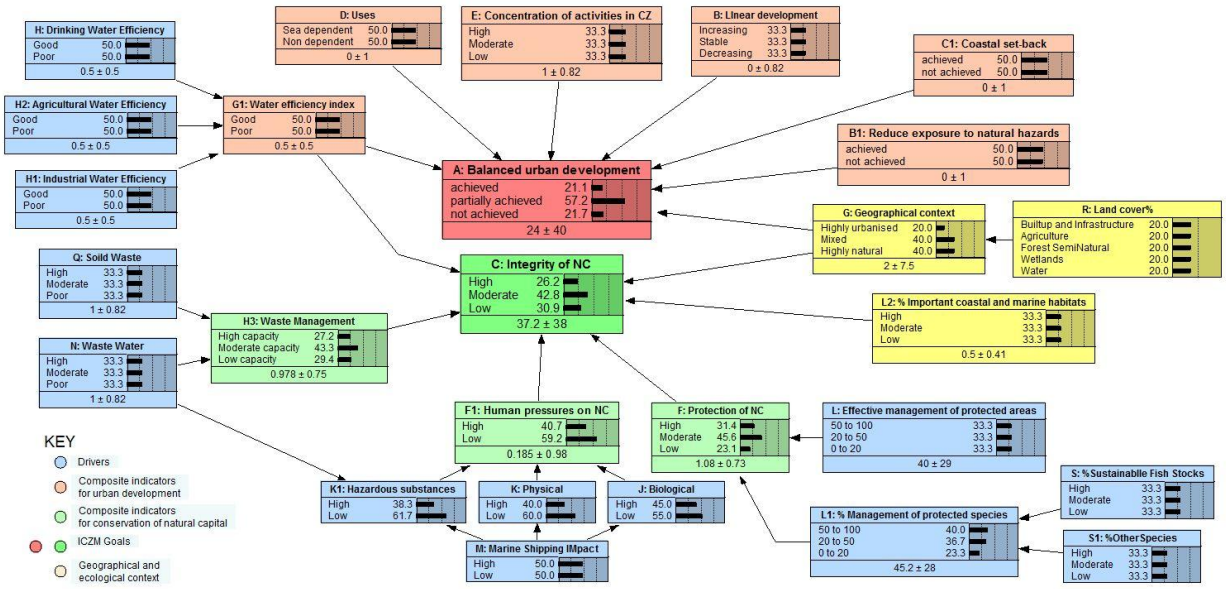
Produce another map of the local economy and associated pressures

The next step is the assessment of associated degradation costs of marine and coastal ecosystems and resources. This step is implemented following instructions given in the PEGASO Deliverable D4.5 section about the coast based approach to assess the cost of coastal and marine ecosystems degradation.

Step 6: Feed the deliberation process based on the shared diagnostic to explore barriers, opportunities and options for ICZM **(scenarios and foresight analysis)**.

Two regional envisioning workshops were implemented for the Mediterranean and Black Sea to test the rationale of the approach. A third consolidated workshop was implemented on March 2013 based on a Bayesian Belief Network approach (see PEGASO Deliverable D4.3 about scenarios guidelines and supporting materials), Box 2.

Box 2 Network of influence of Balanced urban development and Integrity of Natural Capital over the Mediterranean



Causal diagram of urban development and preservation of natural capital issues in the Mediterranean

This network of influence was designed to explore how PEGASO ICZM indicators could be used to characterise and potentially measure the two policy goals of balanced urban development and preservation of natural capital in the Mediterranean. It doesn't cover all factors affecting ICZM, but it is considered to be a useful starting point for discussion, and especially for the development of scenario

Bringing together the collective knowledge and expertise, the participatory visioning workshop was implemented to identify and explore desirable futures for the Mediterranean coastal zones to achieve a balanced urban development (avoid urban sprawl) together with Natural Capital integrity. This was done by:

- exploring what balanced urban development and protection of natural capital mean in the context of ICZM, and how to measure them both qualitatively and quantitatively with support from PEGASO tools;
- building and developing influence diagrams, describing the causal relationships between the variables which drive urban development and preservation of natural capital;
- exploring the consequences of different policy responses and how the issues identified by the participants might develop under different assumptions about the future;

This allows for better understanding the factors that need to be considered in relation to the policy goals. Issues of governance stood out as being of paramount importance. This finding suggested that interventions and efforts to ensure more effective institutional capacity and deeper political commitment are probably essential.

The influence diagram exercise appeared to work well as a vehicle for discussion, and there was some success in using these models as a focus for discussions about the future. These participatory exercises were considered as effective for decision support, and useful ways of engaging with stakeholders. Box 2 illustrates the influence or causal diagram of balanced urban development.

A second illustration is based on an alternative method for visioning exercise and was applied over the Nile delta in Egypt as part of the PEGASO training and capacity building operations. The method is the DEGEST method and was combined with scenarios building (Lacroix 2014). Following a co-construction of a matrix of hypothesis for Egypt regarding Demographics, Environment, Governance, Economics, Society and Technology, then a matrix of plausible and feasible scenarios it issued an example of Impacts of scenarios on Sectors and Actors priorities involved in ICZM together with an example of recommendations for a concrete roadmap in ICZM in Egypt (Figure 8).

Figure 8 Example of recommendations for a concrete roadmap in ICZM in Egypt (2013)

Scenario / Item	**S 1. Utopia or Wonderland**	***S2. Planning in difficulties***	**S 3. Current situation**
SECTOR 1 Natural resources	Optimum use of resources, preservation and ensurance of sustainibility	More stress on available resources	Loss of natural resources
SECTOR 2 Industry and processing	Greener practices, less pollution, reduction of unemployment, Better income, added value of processing, more globalization	Slight improvement	Collapse of industry, rise of black work
SECTOR 3 Services	More services, in quality and quantity	Same situation or may be some slight improvement	Poor or limited services
ACTOR A State, region. authorities Ministries,	Better policy enforcement and rationalisation of policies and legislation, reduction of bureaucracy, better coordination in authorities	More sectorial management and coordination,	Interministerial crisis leading to new decentralised management
ACTOR B Civil society, assoc. NGOs...	Higher level of participation, better awareness of the issues, more support from NGOs	Increase effort s to environment awareness, incentives from state to conservation and protection	Advocacy and examples of local action
ACTOR C Research and development	More applicable research to poorest pop. More funds for R and D, More connection to end users	Provide accurate data to decision makers, need for new technologies	International projects meeting needs
Mix of common recommen-dations	1. Education, notably basic and) training (19 votes 2. More sectoral management and coordination 8 3. Incentives from govt for conservation and protection 2 4. National sectoral strategy for the delta 4 5. Extension to inland spaces and resources 5 6. Sort or review laws to control conflicts of interest 9 7. Ensure the participation of all stakeholders in decision making process 7 8. Encourage investors and clusters to serve the Society 5 9. Support sustainability in all decisions and selections 5 10. Better transfer of intl technology and appropriation 5 11. Share of databases among all decision makers 7 12. Enhancing public awareness as general 3 13. Promoting scientific research 7 14. Create new economic / urban centers 2 15. Support to green technology /ecology engineering 4 16. Better link between Academic science and Industry 9 17. Decentralisation 4		
Selection of a preferable and likely scenario		***S2. Planning in difficulties***	

Lacroix D. 2014

All results are presented in PEGASO Deliverable on Foresight Analysis (Lacroix 2014). Figure 8 presents the output about recommendations for a concrete roadmap in ICZM in Egypt (2013).

Implementation and application of the ETD over the Bouches-du-Rhône CASE

The initial process (Institutional Analysis) of the Environmental Territorial Diagnosis framework was tested and implemented over the Bouches-du-Rhône CASE. It provides a good illustration of the ETD framework, implementing and combining the different tools proposed in the PEGASO economic assessment as well as other PEGASO tools. Entitled "Environmental and territorial diagnosis, CASE Bouches-du-Rhône CASE", the report is available under the CASE documents through the PEGASO portal.

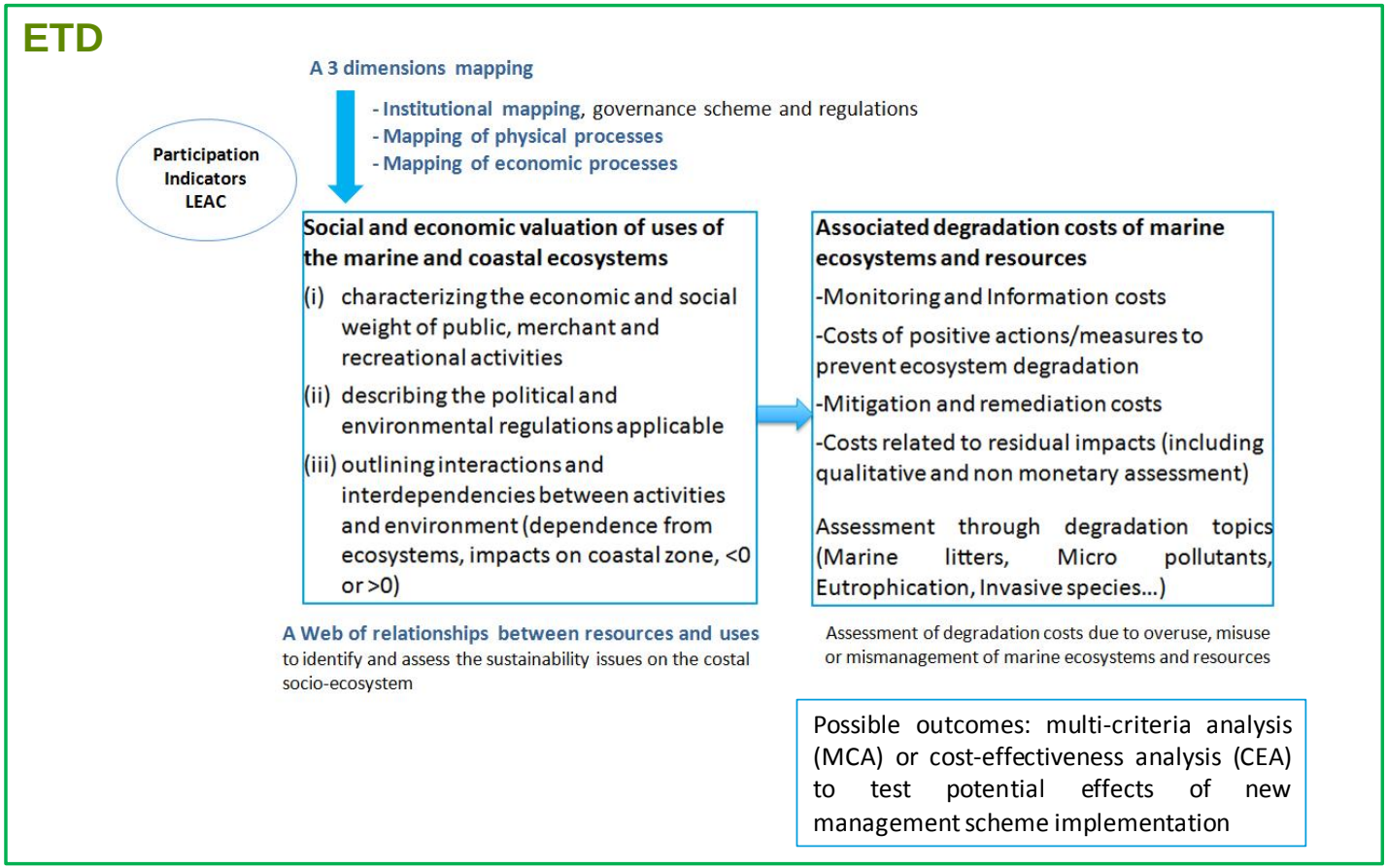
3.4 The consolidated PEGASO integrated assessment framework

Finally the PEGASO integrated assessment scheme can be presented according to Figure 9. It mobilizes most of knowledge produced within the PEGASO project, in attempt to produce an integrated and coherent framework based on a problem oriented approach.

Difficulties rose due to a lack of implementation over several CASES, mainly due to lack of competencies in the different fields of the assessment and especially regarding social sciences. Nevertheless it's a first attempt in building an information system at appropriate scales to feed and support the deliberation and decision making process. This is quite challenging as illustrated by the numerous integration issues over coastal zones. But emphasizing effort to develop, test and maintain such framework is also questioning the way forward PEGASO.

Beyond PEGASO legacy, the approach combining a 3 dimensions mapping can also be seen as communication support facilitating debates and exchanges between stakeholders. There's no need to achieve the ETD in terms of numerical and quantitative achievements. Engaging stakeholders in a common, shared and co-constructed object as represented by the ETD is already a door opened to a positive and common future for the coastal zone.

Figure 9 The PEGASO integrated assessment framework – The Environmental Territorial diagnosis



4. Lessons and roadmap gained from multi-scale tools, methods and models for integrated assessment developed within PEGASO?

4.1 Lessons learned

As many approaches wanted themselves integrated, PEGASO should have immediately focused on the integration beyond of tools instead of proceeding to ex-post integration. Approach should be reversed by defining and structuring an integrated framework before working on tools with the objective of constraining tools to the integrative dimension of the issue. There's also an important need to integrate much more social scientists working in the field of governance and institutional analysis.

It is often difficult to develop tools and alongside transfer them for application. Timescales are different, with needs of more time for development on one side and needs of immediate results for transfer to the decision making process on the other side. This is quite common to a number of projects and for future projects attention should be paid to that point as in most of cases, application sites usually go ahead and finally feed the tools development instead of being fed.

The proposed integrated scheme should be tested and implemented on a wider scale and several study sites to refine tools accordingly.

Scientific Impact

Very few operational integrated assessment frameworks exist in the field of coastal and marine socio-ecosystems. The most operational ones are related to systems dynamics or Individual Based Modelling. Beyond of these modelling approaches (including soft modelling), the added-value of the Environmental Territorial Diagnosis can be significant.

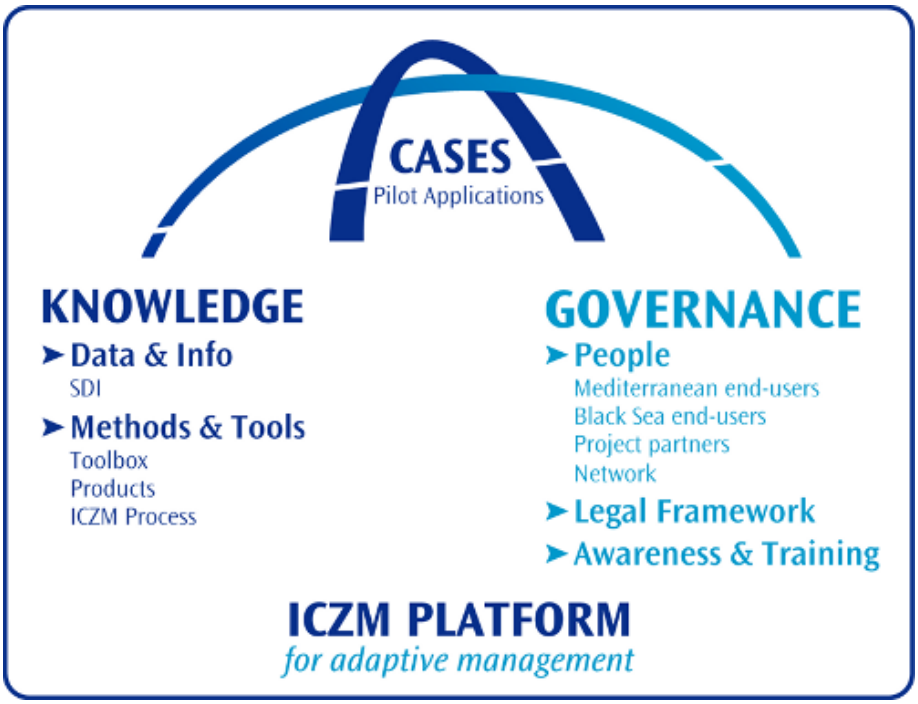
Societal and Economic Impact

Applying the range of PEGASO tools and other available tools available on study sites, the ETD approach proposes a coherent integrated framework from issue appropriation to action. Being problem oriented it allows to integrate actors and end-users all along the process and from the very early beginning.

ICZM Governance platform

PEGASO tools can be linked and used to support a collective expertise in exploring the policy objectives. PEGASO set up an ICZM Governance Platform as a place where knowledge and experiences are shared in view of a co-working and a common understanding between decision-makers and scientists to define consensus by mobilizing collective expertise. Knowledge and governance are the two key-pillars of this platform.

Figure 10 Bridging two pillars of ICZM: knowledge and governance for efficient decision-making



4.2 Needs and way forward

A series of needs can be drawn from the work performed within the multi-scale tools, methods and models for integrated assessment. There is first **a wide range of tools** needed to develop and implement coastal and marine management from a land and sea planning or ecosystem approach perspectives. Many of them are not specific to ICZM but need to be tailored and made available for use or training by CZ managers and stakeholders. There is the material developed and tested by PEGASO, and probably much more available from other projects and networks, for which open access and further development should be secured.

There are also **different categories of tools**. Conceptual and methodological frameworks translating research work and practical experience into comprehensive and operational documents: articles, manuals, guidelines and supporting documentation, including practical examples.

We can use existing guidelines, develop new ones when needed, but the issue is to make them available to practitioners, politicians and researchers in the region, with the major challenge of translation into different languages. Among important support or background tool we have glossaries, WIKI, social networks… But there's a need for repository or links to resources maintained elsewhere and then find some mechanism for feeding and updating.

Indicators and knowledge communication tools

Providing policy making and stakeholder engagement with relevant and easy to understand information is key to sustainable science-policy interfaces. There's again a need to develop:

- indicators and indexes, including innovative ways to produce new data (factsheets),

- and formats to communicate the knowledge gained from their analysis (mapping of spatial data, of institutional design, of interactions in socio-ecological systems,…).

The **data infrastructure** is much more challenging. How not to lose the momentum of data infrastructure development after end of PEGASO: the databases, viewer and atlas but also the network of geonodes? There's need for an institution in charge of running and maintaining the portal: format of contracting with the governance platform lead institution, need for basic financial support… What can be the incentives to maintain geonodes active? There's need for some form of contracting / labelling to enhance recognition.

Some institutional challenges

- Such an infrastructure should serve not only ICZM but different areas of MAP action, a MAP global vision on socio-economic and environmental information needed?
- Need for a "partnership" with research institutions (plus private service providers?) under a format that ensures quality of the service and flexibility in management (ETCs of the EEA?).
- This cannot rely only on the opportunities of projects but need basic funding and institutional recognition to be sustainable.

Way forward?

- Benchmarking on experiences to run data infrastructures for environmental management at international/regional scales.
- Wide consultation among regional intergovernmental bodies, conservation and industry networks to review end-user needs.
- Present a proposal at the next CP meeting including technical specifications, functioning, services, partnership.
- Secure funding for resource center setting (EU?) in the format of project and long term basic funding.
- Or an intergovernmental "club" initiative in support to MAP action ? Have that on the agenda of a high level political event (Union Pour la Méditerranée ?).

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