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D4.1

Report and accompanying fact sheets documenting a populated core set of indicators for assessing progress towards sustainable development in the coastal zones of the Mediterranean and Black Sea Basins

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

Founded by the European Union within FP7 – ENV.2009.2.2.1.4 Integrated Coastal Zone Management

Specific Programme FP7
Collaborative Projects
Large scale integrating Project

Grant agreement n°: 244170

Dissemination Level*	✔ PU	PP	RE	CO
Project Acronym / number	PEGASO	244170		
Project title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast.			

***PU:** Public; **PP:** Restricted to other programme participants (including the Commission Services); **RE:** Restricted to a group specified by the Consortium (including the Commission Services); **CO:** Confidential, only for members of the Consortium (including the Commission Services).

Authorisation

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Date	17/02/2014

Document Information

Project

Project Acronym	PEGASO	Grant agreement nº	244170
Project full title	People for Ecosystem based Governance in Assessing Sustainable development of Ocean and coast		
Funding scheme	Collaborative large-scale integrating project		
Project start date	February 1, 2010	Project duration	48 months
Call topic	ENV.2009.2.2.1.4 Integrated Coastal Zone Management		
Web site	www.pegasoproject.eu		

Document

Deliverable number	4.1	Due date	31/01/2014	Submission date	20/02/2014
Deliverable title	Report and accompanying fact sheets documenting a populated core set of indicators for assessing progress towards sustainable development in the coastal zones of the Mediterranean and Black Sea Basins				
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Work Package	WP4 Multi-scale tools, methods and models				
Work Package Leader	Denis Bailly (UBO)				
Lead beneficiary	IOC-UNESCO				
Dissemination level	PU				
Nature	Report				
Nº of pages (incl. cover)	32				

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Acronyms

CASE(S)	Collaborative Application Site(s)
DPSIR	Driving forces-Pressures-State-Impact-Responses
ICM	IntegratedCoastal Management
ICOM	Integrated Coastal and Ocean Management
ICZM	IntegratedCoastalZone Management
IOC-UNESCO	Intergovernmental Oceanographic Commission of United Nations Educational, Scientific and Cultural Organization
LEAC	Land and EcosystemAccounting
MAP	MediterraneanAction Plan
MSFD	EU Marine Strategy Framework Directive
PAP/RAC	Priority Actions Programme / Regional Activity Centre
RA	Regional Assessment
RA set	Regional Assessmentindicator set
SDI	Spatial Data Infrastructure
SEAC	Sea Ecosystem Accounting
UNEP	United Nations Environment Programme
WP	WorkPackage

1.Introduction

1.1 The role of Indicators in the PEGASO project

The main objective of PEGASO was to build on existing capacities and develop common novel approaches to support integrated policies for the coastal, marine and maritime realms of the Mediterranean and Black Sea basins. This has been done in ways that are consistent with and relevant to the implementation of the Integrated Coastal Zone Management (ICZM) Protocol for the Mediterranean.
In this context, the aim of Work Package 4 (WP4) of PEGASO was to refine and further develop efficient and easy-to-use tools for making assessments of sustainability in the coastal zone.
Task 4.1 provided a suite of indicators that can be applied at different scales, both in the Mediterranean and Black Sea, as sustainability assessment tools, and as a tool to measure the implementation of ICZM policy and programmes.
Within the PEGASO framework, the set of indicators provided by task 4.1 was aimed to:

- **Provide partners responsible for the Collaborative Application Sites or CASES [1] with a simple and ready-to-use set of indicators and detailed descriptions (factsheets) for these indicators;**
- **Support work of the Regional Assessment in the Mediterranean and Black Sea basins;**
- **Provide PEGASO end-users with a set of indicators to be used for the implementation of the ICZM Protocol for the Mediterranean and other relevant policy frameworks (e.g. EU Marine Strategy Framework Directive (MSFD), EU Water Framework Directive).**

The indicators of task 4.1 were structured through three steps (Figure 1):

a) **review of 12 different existing indicators initiatives, covering a total of 310 indicators,** in order to identify the core set of indicators for their application towards **, in particular for the Mediterranean and Black Sea basins;**

b) **assessment of these initiatives against the needs of relevant policy instruments (EU ICZM Recommendation, EU MSFD), EU policies related to the marine and maritime environment (e.g. habitat and bird directives, floods directive, bathing water directive, water framework directive, marine strategy framework directive, common fisheries policy (in review), the integrated maritime policy), the Bucharest Convention, and ICZM Protocol for the Mediterranean;**

c) **proposing new indicators where necessary, taking into account existing recommendations for ICZM indicators.**

As a result of this work, **a core set of indicators** has been identified to support ICZM across the Mediterranean and Black Sea regions; these indicators cover both biophysical issues and socio-economic themes, especially focusing on threats to the coastal zone. A multi-scale approach to indicator design has been adopted to take into account the needs at local, national and regional scales. Furthermore, the data and statistics needed to populate and maintain the indicators have been identified and described in the methodological factsheets in order to help the process of indicators test. Outputs have been tested, across the region and within the 10 CASES areas.

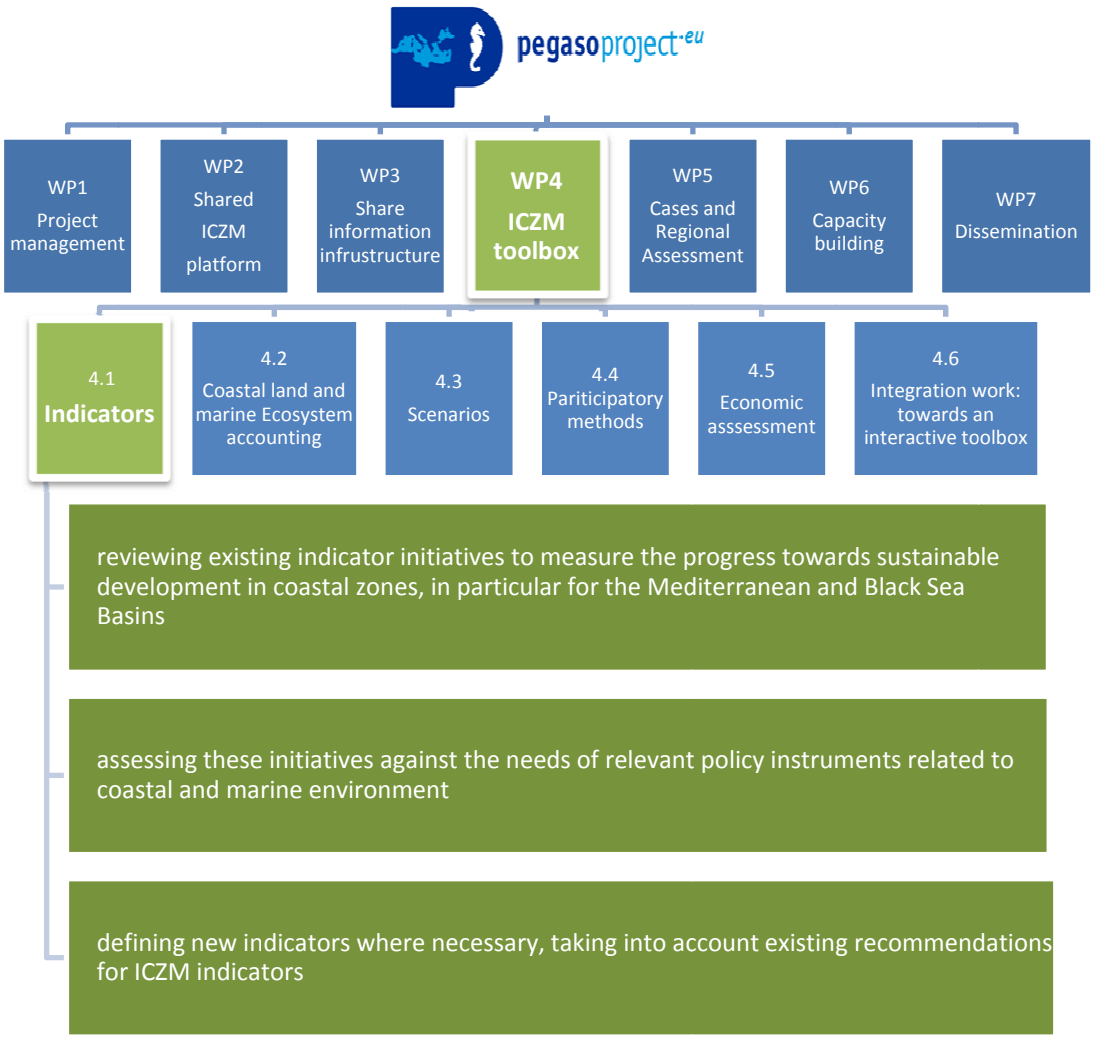

Figure 1 PEGASO Task 4.1 objective

2. Indicators for Integrated Coastal Zone Management (ICZM)

In this chapter a description of the purpose of using indicators in ICZM policies and programmes is provided (2.1), and the requirements for the use of indicators in the implementation of the ICZM Protocol are presented (2.2).

2.1 The purpose of using indicators in ICZM policies and programmes

A structured approach to ICZM results in the need for indicators to measure the progress and effects of ICZM policies. Initiating, monitoring or evaluating an ICZM process requires a set of governance, environmental, and socio-economic indicators that should relate to the specific management issues that triggered the initiation of the ICZM process, such as multiple conflicts, ecological degradation, community interest or the need for implementation of a specific legislation (IOC-UNESCO, 2006). Purposes for application of indicators in ICZM processes include:

1. Monitoring quantified key characteristics of coastal and marine ecosystems against desired conditions (values).
2. Evaluating coastal management options.
3. Tracking progress and effectiveness of implemented measures and actions.
4. Taking into consideration short- and long- term objectives of the plan.
5. Guiding adaptive management.
6. Helping to implement the ecosystem approach.
7. Helping to provide and communicate relevant information to decision makers.

2.2 Indicator requirements for implementing the ICZM Protocol

The ICZM Protocol for the Mediterranean, signed in Madrid in 2008 and ratified in March 2011, represents a milestone for the implementation of ICZM in the region, but also leads by example for other Regional Seas. Furthermore, the Protocol represents a novel approach; being bold, innovative, forward-looking, proactive, comprehensive, and integrated. Regarding the indicators, **Article 27** specifically states that the Parties shall:

> • *define coastal management indicators, taking into account existing ones, and cooperate in the use of such indicators;*
> • *establish and maintain up-to-date assessments of the use and management of coastal zones*

Considering that one of the main aims of ICZM is the sustainable use of coastal resources; indicators for implementing the ICZM Protocol should primarily be linked with the pillars of sustainable development, grouped into three main categories:

- Environmental
- Economic
- Social

Furthermore, a fourth category needs to be considered; **Governance** indicators *"in order to **evaluate the effectiveness** of ICZM strategies, plans and programmes, as well as the progress of implementation of the Protocol"* (**Article 18**).
Therefore, indicators for the Protocol can be grouped into the following categories:

- **Compliance indicators (or Performance Indicators)** - to report on the degree of compliance in the implementation of the Protocol articles, according to the reporting format of the Compliance Committee;
- **Effectiveness indicators (or Impact indicators)** - to measure how effective the Protocol is in achieving its objectives and how successfully the Protocol is being implemented;
- **Coastal management indicators (or Sustainable Development Indicators)**- to assess the state of coastal environments, trends, patterns, sustainability etc.

3. PEGASO Indicators: the approach

In this chapter the approach used to select the ICZM indicator set for PEGASO is described. First the results of a review of major initiatives regarding indicators are presented (3.1). Following, the methodology used to select the set, and from these the core set of indicators is described (3.2). In section 3.3 the links between indicators and other PEGASO tools are shown. In section 3.4 the indicators factsheet template is introduced, integrating the most relevant indicator information. Finally, in section 3.5 the approach used to select and test indicators by end-users of the PEGASO platform (including CASES, experts, and partners involved in the Regional Assessment) is described.

3.1 ICZM indicators review: current status

In order to make use of the pre-existing initiatives on ICZM indicators, a review was undertaken. A summary of the major initiatives that have been reviewed is provided below (for complete information, refer to the Report 4.1. input in deliverable available in PEGASO intranet).

Plan Bleu (Mediterranean Sea):
At the 12th Conference of the Contracting Parties to the Barcelona Convention (Monaco, November, 2001) the 21 Mediterranean rim countries and the European Community decided to prepare a "Mediterranean Strategy for Sustainable Development" (hereinafter referred to as 'the Mediterranean Strategy'). Plan Bleu was in charge of technical coordination, and writing the Mediterranean Strategy draft under authority of the Coordinator of the United Nations Environment Programme Mediterranean Action Plan (UNEP-MAP), with support from other MAP Regional Activity Centres. The Mediterranean Strategy calls for action towards the pursuit of sustainable development goals to strengthen peace, stability, and prosperity. It takes into account the weaknesses of the region and the threats it faces, but also its strengths and opportunities. It also considers the reality of the gaps between developed and developing countries, and stresses the need to help Mediterranean countries in the south, east, and eastern Adriatic to transition towards more sustainable practices. The Strategy is structured around four objectives and seven interlinked priority fields of action. Thirty-four indicators are annexed to ensure an effective follow-up to the Strategy.
The **four main objectives** are:

i) **contribute to economic development by enhancing Mediterranean assets;**
ii) **reduce social disparities by implementing the UN Millennium Development Goals to improve cultural integration;**
iii) **mitigate unsustainable production and consumption patterns, and ensure the sustainable management of natural resources;**
iv) **improve governance at the local, national, and regional levels.**

The seven **priority fields of action** are: water resources; energy management and addressing impacts of climate change; transport; tourism; urban development; agriculture and management of the sea; and coastal areas and marine resources.
The Mediterranean Strategy for Sustainable Development [2] was adopted by the Contracting Parties to the Barcelona Convention in 2005 together with the set of priority indicators. A set of fact sheets related to the Mediterranean Strategy follow-up indicators updated every 2 years is available on the Plan Bleu website [3].
Meanwhile, Plan Bleu developed and used additional indicators, especially for the coastal issues and in the Coastal Area Management Programs (CAMPs) using a participatory approach called "Imagine" [4]
IOC-UNESCO handbook (global):
The ICAM/ICOM pilot program was launched in 2003 under the auspices of the Intergovernmental Oceanographic Commission of United Nations Educational, Scientific and Cultural Organization (IOC-UNESCO), in collaboration with the Department of Fisheries and Oceans (Canada), the National Oceanic and Atmospheric Administration (United States), and the Gerard J. Mangone Center for Marine Policy (University of Delaware). One of its objectives is to promote the development and use of Integrated Coastal and Ocean Management (ICOM) indicators. The IOC-UNESCO pilot project promoted a more outcome-oriented approach to the selection and application of indicators that measure the progress and effectiveness of ICOM interventions. The main project output was the development of a *Handbook for Measuring the Progress and Outcomes of Integrated Coastal and Ocean Management* [5], edited by an international group of leading

experts in ICOM. The structure of the Handbook is built around three main types of indicators; ecological, socioeconomic, and governance performance; and focuses on the ICM policy cycle. It includes an introduction to ICOM, suggestions on how to optimise relationships among these dimensions, and elements for further research on indicators and indicators-based approach for assessing ICOM. In order to validate and receive feedback from potential users, the Handbook is being tested in existing ICOM programmes and projects around the world.

DEDUCE (EU):
The DEDUCE project provided a testing ground for the proposed set of ICZM indicators (proposal from the EU ICZM Expert group and inspired by the INTERREG IIIB SAIL Project in the Southern North Sea http://www.vliz.be/projects/SAIL/index.php) by further defining the broad conceptually identified 'indicators' as operational and replicable 'measurements' (defining temporal and spatial scale, data sources, units of measurements and specific calculation methods), and by testing them in different countries and coastal areas in the EU. These measurements are fully described in technical sheets which are digitally available from the DEDUCE project website www.deduce.eu. The DEDUCE project also provided specific recommendations to further refine the ICZM indicator set and the need for a sustainability assessment framework. The added value of the DEDUCE indicator set is the validation and agreement it received from EU countries as a first basic step.

Over 300 indicators were initially identified by the PEGASO review exercise, focusing on – but not limited to - the 3 initiatives described above. As a second step, the indicators presented in at least two reviewed initiatives were selected. Then a further review analysed the actual formulation (wording) of individual indicators. That analysis revealed that despite some indicators had different definitions or formulations, they referred to the same objective. Following that process, some indicators that had not been included in the second step were re-introduced to the core set. In addition, that list was submitted for discussion to an ad hoc group of experts during a meeting held in the IOC-UNESCO offices on September 8, 2011. As a result of their open discussion and evidence-based contributions on behalf of invited experts, a number of additional indicators were suggested, particularly for economic indicators.

Initiatives	Leader	Partners
WGID	ETC-TE	EU members state representatives to the European expert group on Integrated Coastal Zone Management ICZM
DEDUCE	Department of the Environment and Housing of the Catalonia government	http://www.deduce.eu/PDF-NewsLetter/indicators_guidelines.pdf 9 partners in 6 countries (Belgium, France, Malta, Poland, Spain, Latvia): University of Latvia, Maritime Institute of Gdansk, province of West-Flanders, French Environmental Institute, Malta Environmental and Planning Agency, Government of Catalonia, Catalonia municipalities (3),
SAIL	VLIZ	6 partners in 4 countries (Belgium, France, Netherlands, United Kingdom): Counties of Kent and Essex, Thames and Essex Estuary Partnerships, Province of West-Flanders (B), regional Government of Nord-Pas-de-Calais (France), Province of Zeeland (NL),
BIP	IMEDEA	The Balearic Statistics Institute (IBESTAT) and the Socio-environmental Observatory of Menorca (OBSAM)
CAMPs	Plan Bleu	UNEP/MAP/PAP and Plan Bleu, National and local institutions according to the CAMPs initiatives
MSSD	Plan Bleu	UNEP/MAP, MCSD, Plan Bleu, National Institutions such as Misnistry of Environment, Environment observatory, Statistical offices, ...
MWO	Tour du Valat	See the list of partners on http://www.medwetlands-obs.org/en/content/partnerships
SB	MHI	

3.2 The approach for selecting indicators

In this chapter the approach used to select the indicators to be applied in the PEGASO project is described; starting with the ICZM Protocol policy objectives (3.2.1), the indicator set (3.2.2), and the core set of indicators (3.2.3). Finally the testing phase of the indicators in PEGASO is explained (3.2.4).

3.2.1 Selecting the policy objectives covered by the indicators

In order to promote an integrated (ecosystem) approach and to overcomethe traditional sectoral (e.g. fishery, tourism, energy) approach, in accordance with the DEDUCE approach, it was decided to **link the PEGASO set of indicators to the 10 ICZM policy objectives, reflecting the principles of ICZM which can be found in Article 6 of the Protocol**. The 10 policy objectives were taken from the PEGASO draft deliverable (2.1.1a), in which the ICZM principles from the Protocol were redrafted in order to reflect the relationship between ICZM and the Ecosystem Approach. Furthermore, the policy objectives were linked to specific ICZM Protocol articles which reflect these ICZM principles, as redrafted in the conceptual paper table in ANNEX I.
Thematic indicators were also taken into account, but the selection and application of the indicators provided additional information around specific ICZM plan objectives, e.g. how to increase the resilience of coastal zones to natural hazards and climate change impacts rather than finding solutions for coastal erosion.
After further reflection on the links between indicators and policy objectives, a decision was made to exclude for the purpose of selecting and linking indicators, two policy objectives from the overview and framework. This does not, however, mean that these two policy objectives were considered as not policy-relevant, or that the selected indicators do not implicitly relate to these policy objectives. Rather, the explicit relation between indicators and the policy objectives constituted subject for further work at the time of the analysis:
-The policy objective that states elements are *not to exceed the carrying capacity of the coastal zone* (Article 6(b)), was not included in the final overview linking indicators and policy objectives. This resulted after a consultation with PAP/RAC (Priority Actions Programme / Regional Activity Centre) colleagues highlighted the need for more research and discussions on the concept of “carrying capacity” for coastal zone management.
- The policy objective to “*adopt a long-term approach to fully take into account temporal scales*” was not explicitly linked to indicators because it is considered as a cross-cutting policy objective that can be measured by applying indicators related to other policy objectives such as those related to the formulation of land use strategies and plans.

3.2.2 Developing the Indicator set from policy objectives

In accordance with the eight policy objectives that were retained for explicitly inking with indicators, a set of 67 indicators (Indicator set file) were selected from the review of the experiences from Plan Bleu, IOC-UNESCO, and DEDUCE indicators. Each policy objective was represented by at least four indicators. Furthermore, each indicator was linked to the corresponding ICZM Protocol article and ecological objective of UNEP-MAP. These ecological objectives have been finally defined as part of the roadmap application of the Ecosystem Approach in the Mediterranean, with a view to implementing the EU Marine Strategy Framework Directive (**Annex II** UNEP-MAP Ecological Objectives).

3.2.3 Developing the core set from the Indicator set

Starting with the PEGASO indicator set of 67 indicators, a subset (**core set**) of 26 indicators was identified (**Annex III)**. Thefollowingcriteriafor selectionwereused:

- **The requirement to include indicators covering the** main priority issues of the ICZM Protocol **(e.g. urban sprawl, land use, and coastal habitats)**
- **The requirement to include the indicators for** UNEP-MAP ecological objectives **related to coastal zones**
- **The need to include the four** main economic indicators **(i.e. those considered by economic experts as the minimum requirements for describing a coastal economy)**

With regard to governance (or compliance) indicators, it was considered that the stocktake performed in WP2 would provide the necessary information at the regional level, therefore in an attempt of avoiding duplication that category of indicators was not included in the core set. It has made possible at the CASES level to easily identify and extract indicators referring to policy objectives on governance from the full indicator set list.

3.2.4 Testing phase of the indicator core set

The testing phase of the core set of indicators was implemented at the two main spatial scales as defined in the PEGASO description of work: the Regional, and the CASES (local, national, subregional) scale. A Regional Assessment indicator set (RA set) was selected from the core set of 26 indicators. The most relevant indicators from the PEGASO indicator set (15) were selected for the specific issues of the various CASES.

Timing	Start - March 2011	Mar 2011 -Sep 2011	Sep 2011- Dec 2011	Dec 2011- Feb 2012	Feb 2012 - April 2012
Process	Initial review (from previous initiative)	Second review (check for wording and indicator objective)	Selection of PEGASO set and Approach development	Selection of core set	Development of methodological factsheet Methodological paper First draft of RA set
Product	List of 300 indicators Input in deliverable	List of 300 indicatorsrevised	PEGASO set (67 indicators)	Core set (15 indicators)	Methodological factsheets (15) Methodological paper (input in deliverable) RA set

Figure 2. The process of selecting the PEGASO indicator set, and core set. A proposal for the RA set can be found in Annex IV

3.3 The methodological Indicator factsheet: Applying integration in the Indicator assessment

For each indicator from the core set (15), a **methodological factsheet** (Table 1) has been compiled. The factsheets reflect the way in which the PEGASO indicators can and should be conceived and organised. The factsheets are available from the PEGASO project website and are disseminated through the wider group of potential users through the Coastal Wiki [6].

The first part of the factsheet illustrates the **policy context** with reference to the ICZM policy objectives, the Articles of the ICZM Protocol, and the UNEP-MAP Ecological objectives.

The second part of the factsheet includes information on the **steps to be followed** to calculate the indicators. It also provides information related to timeframes and spatial scales at which the indicator is expected to give the most robust output and application (e.g. local, national, regional). It also includes reference to suggested data sources and current monitoring programmes and systems.

The last part of factsheets refers to the indicator's **assessment context**. These fields describe the relevance of an individual indicator within the framework of application: position in the Driving forces-Pressures-State-Impact-Responses (DPSIR) framework; the indicator's category i.e. the methodologies or tools for which indicators can be instrumental; and where available, the quantitative or qualitative targets/thresholds/reference values for the indicator, and the sources of these values. The factsheet template can be downloaded from the coastal Wiki [6]

Table2. Indicator factsheet template [6]

Indicator (name)			
Nr.			
Objective of theindicator			
Policycontext			
ICZM PolicyObjective			
ICZM ProtocolArticle			
Relevance of the indicator for ICZM Phase(s)			
UNEP-MAP EcologicalObjective			
Spatialconsideration			
Coverage		Resolution	
Temporal consideration			
Period		Resolution (time interval or unit)	
Parameter(s)			
(i)			
(ii)			
Calculationmethod			
Steps		Products	
1			
2			
…			
Currentmonitoring		**Data sources**	
Assessmentcontext			
Use of the indicator in previous assessments/initiatives			
DPSIR framework			
Link to anthropogenicpressure			
Sustainability target orthreshold			
Link with other assessment tools			
Example of integratedassessment			
Scope for futureimprovements			
Indicatorreferences (i.e. UNEP, EEA, …)			

The PEGASO set of ICZM indicators does not only serve as a descriptive, but also as an analytical tool for understanding of coastal systems. The indicator set can be applied at the scale of the regional sea (the Mediterranean or the Black Sea), and a national or local coastal area. The challenge is to perform an integrated, comprehensive assessment by measuring indicators, with both qualitative and quantitative value. To achieve this, **cross-linkages of indicators** are needed between: Indicators of Sustainable Development and Indicators of Governance, DPSIR indicators, cross-cutting issues, themes, and sectoral objectives. A particular attention needs to be paid to **cause-effect relationships** and to processes that define these relationships at the scale of analysis, when selecting these cross-linkages. For example, at the regional level, to measure the link between an increase in the volume of handled goods in ports and the emission of greenhouse gases, a composite indicator could be measured such as, '*$C0_2$ emissions by shipping and maritime transport, per annum per unit of handled goods (e.g. container or bulk) in ports'*. For an example at the local level, to measure how overnight stays in tourism relate to the creation of local jobs, a composite indicator could be created such as, *'number of overnight stays per unit of employment'.* The policy relevance of the indicator in this example may be further enhanced by calculating its values for different seasons, in particular in those coastal areas where a strong seasonality exists in tourism and recreation.

3.4 Selecting and testing indicators from the PEGASO indicator set

After having described the methodology used to develop the indicator set and core set, in this section the approach used in the selection (3.5.1) and testing (3.5.2) process by end users (i.e. CASES and partners involved in Regional Assessment) is described.
To summarise, the following steps should be taken to select and test the indicators:

1. **Context-specific identification** of priority the ICZM **policy objectives** for a region to CASE scale application
2. Selection of a **subset of indicators** from the proposed indicator core set (Annex II)
3. **Data collection and calculation** of the selected indicators
4. **Analysis and interpretation** of the indicator data results in the context of sustainability targets and the ICZM policy objective(s), linked with other PEGASO tools
5. **Presentation** to stakeholders
6. **Feedback** to the task 4.1 team on the above steps through questionnaires and Virtual Meeting

3.4.1 Selecting indicators

The PEGASO indicator set has been identified for each ICZM policy objective. Therefore, the process of selecting indicators begins with the **identification of the policy objectives** that are most relevant for the specific coastal system. The process of selection can be performed in a participatory manner with coastal stakeholders to define the priority issues, and evaluating of how these issues are related to existing policies, plans and objectives (See participation methods: refer to relevant WP5 outcomes/reports, and to the coastal wiki page on PEGASO Participation Methods: http://www.coastalwiki.org/wiki/PEGASO_participation_methods). Suitable Policy-relevant indicators can be selected to measure and monitor the identified policy (plan/programme) objectives.

When selecting the indicators to be measured in the Collaborative Application Sites or CASES [1] or for the Regional Assessment, pragmatic issues should be also taken into account. These issues refer mainly to **relevance and data availability**. The process of identification and collection of data for measuring indicators can be difficult and challenging (Figure 2). Therefore, a preliminary process is critical to ranktherelative importance of indicators in relation to the ease of their evaluation (data availability) (Figure 3) (cf. the Imagine approach) [7].

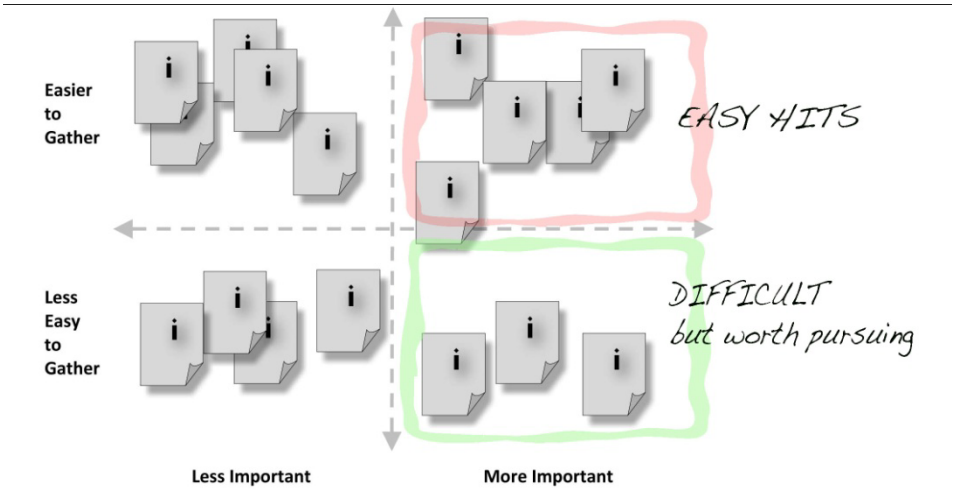

Figure 3. Ranking of indicators according to the Plan Bleu IMAGINE method (adapted from CAMP Slovenia, 2005 [8]).

3.4.2 Testing indicators

The final aim of task 4.1 was to provide a robust set of indicators for the ICZM community in the Mediterranean and Black Sea regions. Therefore, a number of important issues had to be considered when testing the indicators both in the CASES and in the Regional Assessment. Feedback was provided at the end of the testing phase in order to update, modify or exclude indicators included in the initial PEGASO indicator set. To capture experiences and lessons learnt during the testing phase in different regions, a questionnaire was circulated to

provide necessary feedback to the Task 4.1 team (Annex IV: Use and Effectiveness of Indicators, Feedback Questionnaire).

The **main issues** identified to take into account during this testing phase were:

- **Indicator Robustness**: the need to test the relevance of ICZM indicators at different spatial scales, in different policy environments, and for different policy objectives
- M**ethodological robustness**: the need to apply and calculate ICZM indicators at different spatial scales and governance levels, gaining a benchmark for different regions, to test robustness of the developed calculation methodologies
- **Availability of data and robustness of datasets:** in order to allow interpretation of the ICZM indicator results at different spatial scales and governance levels
- **Sustainability Framework:** the need to detect, test and validate causal effects using a combination of selected indicators, within a logical framework (the DPSIR) addressing policies for sustainable development in coastal zones
- **Sustainability Targets and thresholds**: the need for reference values against to which evaluate whether the coastal zone(s) is/are progressing towards more sustainable conditions

3.4.3 Integrating indicators with other PEGASO products

The selected indicators were consistently applied in a wide range of spatial scales (i.e. local, national and regional), in line with the multi-scale PEGASO approach. Indicators also need to be linked with other PEGASO tools (WP4) and products such as the Spatial Data Infrastructure (SDI; WP3).

Examples of methodological integration between the set of indicators and other ICZM WP4 tools:

- **To cover and analyse the spatial dimension of the PEGASO indicators, the spatially explicit indicators can be integrated with the** Land and Ecosystem Accounting (LEAC) and the Sea Ecosystem Accounting **(**SEAC**; task 4.2)**
- **The set of the PEGASO indicators provides a possibility for a DPSIR baseline assessment of current and past coastal and marine system pressures, states and impacts, against which trends can be analysed, and future projections can be assessed through** scenario development **(task 4.3)**
- **Economic indicators can be a component of a** socio-economic evaluation **(task 4.5)**
- **The selection and identification of appropriate indicators for specific CASES should be performed through** participatory methods **(Participation methods report) (task 4.4)**

Dissemination of the Indicator end products in the PEGASO Spatial Data Infrastructures

Within the PEGASO project, the ICZM Governance Platform was supported by the development of a **Spatial Data Infrastructure (SDI)** and the suite of sustainability assessment tools required for making multi-scale integrated assessments in the coastal zone. The PEGASO SDI is developed to support ICZMfor the Mediterranean and Black Seas and this SDI consists of **3 components: the Map Viewer, the Data catalogue and the Atlas**.It is a technical platform that integrates all (spatial) data products. The PEGASO Atlas is an online tool that combines interactive maps with text and images, organized in different sections or topics. It consolidates existing data in a state of the art mapping and visualization platform allowing end users to analyze coastal data and PEGASO products, including the indicators end products, the indicators factsheets, the Integrated Regional Assessment products and other relevant project's outcomes.. The Data Catalogue allows a structured search in the spatial data layers shared through the network of geonodes, and can then be visualized through the Map Viewer.

The SDI provides the necessary capacity and training capabilities for the creation of local geonodes within participating institutions. Through the creation of these geonodes, harmonised Mediterranean and Black Sea datasets have been made accessible through the Internet Map Viewer and Data Catalogue, and disseminated through the PEGASO Atlas [see ref 13]. PEGASO has provided harmonisation of data and metadata, which are critical for building assessment tools (WP4) to support the regional assessment (WP5).

3.4.4 Using indicators at local and regional scales

The purpose of the PEGASO project (WP4.1) was to test and use the PEGASO set of indicators at the multi-scale level, and to test their robustness at different spatial scales, in terms of:

- policy-relevance**: is the indicator relevant both at the local scale and basin-wide?**
- calculation and representation: **is a common methodology, harmonization and visualisation feasible and relevant, covering different spatial scales?**

Therefore, the role of the PEGASO CASES represents a crucial component of the work on indicators both in the Mediterranean and Black Seas.

Selecting indicators for PEGASO CASES

The following steps describe how to choose and test indicators in PEGASO CASES:

1. **Consider CASES objectives in relation to the desired role of the indicator (e.g. compliance indicators, effectiveness indicators, coastal management indicators; see section 2.2)**
2. **Compare the CASES objectives with the ICZM policy objectives of the indicator core set (Annex II) choosing those that best match the needs of the CASES**
3. **Select the indicator(s) of the policy objective set that best describe the issue**
4. **Consider other objectives of the CASES and link the chosen indicator(s) with those from the core set table* (Annex III) regarding relationships among them (i.e. driving force, pressure, state, impact, and response)**
5. **Test theindicators**

*Subsequently it is possible to choose other indicators from the indicator set file.
It is important to employ a participatory method throughout all stages of choosing indicators (Task 4.4).

Example CASE: Al Hoceima coast (Morocco)

1. Consider CASES objectives in relation to the desired role of the indicator

Some of the most relevant coastal issues in the Al Hoceima coast CASE were related to climate change, such as erosion. One key objective was therefore the assessment of coastal vulnerability to climate change especially to sea-level rise and storm surges. This highlighted a need for indicator(s) that would assess the state of the coastal environment, therefore a coastal management indicators were chosen.

2. Compare the CASES objectives with the policy objectives of the indicator core set (Annex II) choosing those that best match the needs of the CASES

Based on the core set table (Annex II), the CASE objective *to assess coastal vulnerability to climate change* with particular relevance to phenomena such as erosion, complies with the policy objective *to prevent damage to coastal environment, and appropriate restoration if damage already occurred*.

3. Select the indicator(s) of the policy objective set that best describe the issue

Several indicators relate to the identified policy objective, yet *Areal extent of coastal erosion and coastal instability* (indicator no. 17, Annex III) is the indicator that best describes the problem. This indicator is defined as providing *a description of the vulnerability of the coastal zone to events that can cause erosion and instability of the coastline*.

4. Bear in mind other objectives of the CASES and link the chosen indicator(s) with those from the core set table (Annex III) considering the relationship among them (i.e. driving force, pressure, state, impact, and response)

Other objectives of the CASE are to increase the well-being of the local population and to develop coastal adaptation strategies to mitigate impacts from climate change. Therefore the selected indicator (no. 17, Annex III) can be linked both to indicators of the same policy objective, as well as indicators placed in two other policy objective sets:

- *To prevent damage to coastal environment, and appropriate restoration if damage already occurred.* **Measuring the area subject to physical disturbance can be useful to determine possible pressures that increase erosion phenomena. Furthermore, risk assessments can be the first response in understanding to what degree the population and human activities are under risk of erosion.**

    - Indicator no.18: Areal extent of sandy areas subject to physical disturbance (beach cleaning by mechanical means, sand mining and beach sand nourishment)
    - Indicator no.19: Risk assessment: economic assets at risk of storm surges and coastal flooding (considering sea level rise scenarios and return periods of storm surges)
    - Indicator no.21: Risk assessment: Populations living in the at-risk area of storm surges and coastal flooding (considering sea level rise scenarios and return periods of storm surges)

- *To formulate land-use strategies, plans, and programmes covering all coastal and marine uses.***The lack of a plan can lead to detrimental land use of vulnerable coastal zones.**

    - Indicator no. 4: A governance system and legal instrument in support of Marine Spatial Planning is in place. (Yes / No)
    - Indicator no.5: There are spatial development plans which include the coastal zone but do not treat it as a distinct and separate entity.

- *To have a balanced use of the coastal zone and avoid urban sprawl.***The trend of populations living in an at-risk area should be identified.**

- *To have a balanced use of the coastal zone and avoid urban sprawl.* The trend of buildings andpopulations living in an at-risk area should be identified.

    - Indicator no. 11: Area of built-up space in the coastal zone (both the emerged and submerged area of the coastal zone
    - Indicator no. 13: Changes in the size, density, and proportion of populations living on the coast
    - Indicator no. 22: Productive and protected areas lost due to siltation, saltwater intrusion

5. Test the indicators

In order to test the PEGASO set of indicators at the multi-scale level, the PEGASO partner or CASE was invited to calculate the indicators corresponding to its area of activity/study/ within the project. The indicators were calculated from **local 'reference' datasets** to which an **algorithm of calculation** (percentage, division, addition, etc...) was applied to determine the value of the respective indicator. The algorithm was explained in the indicator methodological factsheets (ref to Annex/PEGASO coastal wiki).
The PEGASO indicators refer to zones or geographic areas: a coastal zone, a buffer of 1km or 10 km of coastline, municipalities or NUTS4, sea areas, protected areas, etc. Geographic areas for the spatial reference of indicators may correspond to predetermined geographical areas but they may also be unique and purposely created as 'reporting unit' for the visualisation of the indicator. A **Reporting Unit**could be defined as any collection of spatial objects to which reporting information can be associated or linked to. In the PEGASO Project, the partners were invited to use the INSPIRE spatial objects called 'Reporting Units'. Furthermore, within each area or territory, the indicator could be calculated at different 'scales' resulting in different indicator values. These 'scales' could then be compared or used as baseline material. As an example: the calculated indicator value for 'built-up area' in the amalgamated (joint) coastal municipalities within a NUTS2 territory can be compared to the calculated indicator 'built-up area' value for the entire NUTS2 territory. By doing so, the characteristics of 'built-up area' in the coastal area (i.e. collection of coastal municipalities) can be compared or benchmarked to a wider reference area, to visualize or underline the unique features of the urban development

in the coastal zone as a territorial unit. Suggested scales of calculation, and visualisation, were included in the PEGASO indicator methodological factsheets.
After calculation, the partners were invited to summarize the indicator results in a summary report and assess the usefulness/relevance of the indicator and the calculation outputs, in the evaluation questionnaire (see above and Annex IV). The partners/CASES were invited to publish the calculation results that are spatially explicit, through the established geonodes. By publishing the indicator end products and spatial layers through the geonodes, it is possible to:

- **share, exchange and compare spatial data from different coastal regions**
- **create a common understanding of the particular features of the coastal zone in the Mediterranean and Black Sea region.**

However, as a precondition to achieve this, a harmonization process is mandatory. A first step in this harmonization is provided by the instructions in the indicator factsheet, and refers to:

- **agreed semantics, definitions and standards (e.g. 'unemployment' or 'built-up area'; units of measurement)**
- **agreedalgorithms for calculation**
- **agreed spatial and temporal coverage and resolution, including agreed reporting units**

The products of calculations may have a wide range of different values for the different areas/scales considered. For a common visualisation on a map, it is therefore mandatory to define:

- number of categories/classes and ranges of values to consider for each class (e.g. 'low', 'high')
- colourorcolourrange for representation
- whereapplicable,theappropriatesymbology

Full-detailed proposals for harmonization guidelines were further developed for the indicators*area of built-space*, *natural capital* and *population size and density* (see Annex V). With the harmonization process, important efforts were conducted to i**mplement the INSPIRE specifications** (see **INSPIRE Feature Catalogue** and feature concept dictionary: http://inspire-registry.jrc.ec.europa.eu/; for more information on the SDI and harmonization guidelines: see D3.2).

Selecting indicators for the Regional Assessment

The PEGASO Integrated Regional Assessment (IRA) was designed to address the complexity of multidimensional issues related to the coastal and marine environment of the Mediterranean and Black Seas. Specific objectives were to (1) build a multidisciplinary assessment of best available information, (2) inform policy, and (3) support decision making in the context of the ICZM Protocol. The PEGASO IRA goes beyond a mere state-of-the-environment report. Main objectives of the IRA were to thoroughly analyse how human activities impact ecosystems, and how these affect the resilience to continue providing ecosystem services. It was not, however, an intention to provide a comprehensive assessment of the state of marine and coastal ecosystems. The IRA gives particular focus to trends and future changes including scenarios and socio-economic valuation. The PEGASO IRA was intended to be a policy-oriented tool with two specific objectives: to inform the relevant policy- and decision- makers on how to implement the ICZM Protocol in the Mediterranean region, and to pave the way towards the development of a similar legal instrument in the Black Sea region.

In the context of the IRA, the objectives of indicators were twofold;

1. **To describe temporal and spatial causal effects i.e. describe relevant phenomena in the Mediterranean and Black Seas by considering cause-effect relationships**
2. **To provide the baseline for scenario exercises**

A preliminary proposal for the selection of an RA set was made by considering the following steps:

1. Selection of policy objectives **i.e. the priority issues for the Mediterranean and Black Sea basins**
    a. Preserve the wealth of natural capital in coastal zones
    b. Priorities public services and activities in close proximity to the sea, and take into account the specific characteristics of the coastal zone when making decisions about coastal uses
    c. Prevent damage to the coastal environment, and appropriate restoration if damage has already occurred

d. Definition of a conceptual framework (e.g. Transboundary Waters Assessment Programme scheme, DPSIR modified)
e. Selection of indicators

To arrive at a shared decision about the RA set discussions were undertaken in the context of workshops and virtual exchange among partners and PEGASO end-users.

Conclusions

In this report we presented the work undertaken in the context of the PEGASO project for the development of ICZM indicators to be applied at different spatial scales, from local to regional, and as tool for measuring the implementation of the ICZM Protocol for the Mediterranean.
It was mainly because we developed a tool for the ICZM Protocol that we decided the link the indicators present in the PEGASO set to ICZM principles and policy objectives taken from the article 6 of the Protocol itself. However, one can say that these are widely applicable ICZM principles also outside the Mediterranean basin. The main message is that in order to promote a truly integrated approach we should avoid measuring the achievements of coastal management plans and programmes by using sectorial indicators taken in isolation. Indicators should be used in an assessment framework, e.g. the Drivers, Pressures, State, Impact and Responses (DPSIR) in order to provide information about where we are in meeting policy and management goals and objectives. This has proven to be a useful approach for the work done in the context of the PEGASO CASES and also in the context of the PEGASO IRA to help identifying policy and management objectives.
While the general approach has been accepted and considered useful by the PEGASO partners, it is to be said that the use and the calculation of the indicators was not a straightforward task. This was due in particular to the lack of data or, when data were available, to problems related to formats and free access. This was particularly true in the non-EU partner countries. An important lesson learnt is that what is needed is a further discussion on data management governance, and that this discussion should be done not only within the scientific community but also with the concerned institutions. Therefore, important implications related to how the spatial and statistical data are managed and acquired will have to be carefully analised and proposed to the relevant institutions and authorities. If we want to create a basin-wide view of the Mediterranean, if we want to create a baseline to measure in the future progress towards the achievements of the objectives set by the Protocol (or also by other marine and coastal legislation) it will be crucial to consider issues like data sharing, and data standards among EU and non-EU countries.
It is also for this reason that the PEGASO indicators can be considered as a work in progress that will continue in the future. It will be important to create mechanisms for further elaboration of the methodological factsheets in order to take into account the experience acquired during the PEGASO project.

ANNEX I
Redrafted ICZM Principles and policy objectives of ICZM Protocol Article 6.

Redrafted ICZM Principles	Policy objective
1. ICZM seeks to take account of the wealth of natural capital in coastal zones represented by ecosystems and the output of ecosystem services that depend on the complementary and interdependent nature of marine and terrestrial systems. Thus policy makers and managers should consider the effects of their actions and activities on those social, economic and environmental systems that affect the coastal zone or are affected by processes within it, by considering the cross-sectoral implications of all plans and policies.	Preserve the wealth of natural capital in coastal zone
2. All elements relating to hydrological, geomorphological, climatic, ecological, socio-economic and cultural systems shall be taken into account in an integrated manner, so as not to exceed the carrying capacity of the coastal zone and to prevent the negative effects of natural disasters and of development. Policies and plans in the coastal zone should therefore ensure that ecosystems are managed within the limits of their functioning.	Not to exceed the carrying capacity of the coastal zone
3. The ecosystem approach to coastal planning and management should be designed to ensure the sustainable development of coastal zones. This implied that not only should ecosystems be managed within the limits of their functioning, but also that full account is taken of the varying temporal scales and lag-effects that characterise ecosystem processes. As a result, ICZM should look to the longterm so that sustainable development can be achieved.	Adopt a long-term approach to fully take into account temporal scales
4. Appropriate governance allowing adequate and timely participation in a transparent decision-making process by local populations and stakeholders in civil society concerned with coastal zones shall be ensured. In doing so ICZM recognises that the management of land, water and living resources is a matter of societal choice. This will require that all relevant sectors of society and scientific disciplines should be involved in framing the options, and that all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices be taken into account. In particular the way different groups value ecosystem services should be understood.	To ensure appropriate governance allowing adequate and timely participation in a transparent decision-making process of all relevant social actors
5. Given the requirement for cross-sectoral management approaches in the coastal zone, the institutions dealing with social, economic and environmentalissues must themselves be organised in ways that allow integrated approachesto be developed. This will require that appropriate institutional capacity bebuilt and that decision makers should be competent in using all the forms ofevidence that need to be taken into account.	To ensure cross-sectorial coordination among competent authorities

6. The formulation of land use strategies, plans and programmes covering urban development and socio-economic activities, as well as other relevant sectoral policies are needed for successful ICZM. However, their impacts need to be assessed, and the implications considered in terms of the trade-offs between the natural, economic, social and cultural capitals.	To formulate land-use strategies, plans, and programmes covering all coastal and marine uses
7. ICZM is essentially place-based and should take account of geographical context. In particular, it must recognise and communicate the particularqualities, characteristics and opportunities in the coastal zone that arise from the proximity of land and sea, and take steps to protect and sustain them. Thus management should be decentralized to the lowest appropriate level to ensure that management or policy goals are understood and owned by those who affect their implementation and success.	To give priority to public services and activities requiring the proximity to the sea, and to take into account the specific characteristics of the coastal zones when deciding about coastal uses
8. The allocation of uses throughout the entire coastal zone should be balanced.	To have a balanced use of coastal zone, and avoid urban sprawl
9. Preliminary assessments shall be made of the risks associated with the various human activities and infrastructure so as to prevent and reduce their negative impact on coastal zones. Although such risk assessments should take account of the limits of ecosystem function, assessment must also recognise that change is inevitable, and so must be updated by periodic assessments in the light of changing circumstances. ICZM must be framed as anadaptiveprocess.	To perform Environmental Impact Assessment for human activities and infrastructures
10. Damage to the coastal environment shall be prevented and, where it occurs, appropriate restoration shall be effected.	To prevent damage to coastal environment, and appropriate restoration if damage already occurred

ANNEX II

UNEP MAP Ecological Objectives

From:

Draft decision on implementing MAP Ecosystem Approach roadmap: Mediterranean Ecological and Operational Objectives, Indicators and Timetable for implementing the ecosystem approach roadmap

Ecological Objectives	Operational Objectives	Indicators
1 Biodiversity		
Biological diversity is maintained or enhanced. The quality and occurrence of coastaland marine habitatsand the distribution and abundance of coastaland marine speciesare in line with prevailing physiographic, hydrographic, geographic and climatic conditions	**8.2 Key coastal and marine habitats are not being lost**	**8.2.1 Potential / observed** distributional range of certain coastal and marine habitats listed under SPA protocol 8.2.2 Distributional pattern of certain coastal and marine habitats listed under SPA protocol **8.2.3 Condition of the habitat defining species and communities**
7 Hydrography		
Alteration of hydrographic conditions does not adversely affect coastal and marine ecosystems.	7.2 Alterations due to permanent constructions on the coast and watersheds, marine installations and seafloor anchored structures are minimised	7.2.1. Impact on the circulation caused by the presence of structures 7.2.3 Trends in sediment delivery, especially in major deltaic systems 7.2.4 Extent of area affected by coastal erosion due to sediment supply alterations
8 Coastalecosystems and landscapes		
The natural dynamics of coastal areas are maintained and coastal ecosystems and landscapes are preserved	8.1 The natural dynamic nature of coastlines is respected and coastal areas are in good condition	8.1.1. Areal extent of coastal erosion and coastline instability 8.1.2 Changes in sediment dynamics along the coastline 8.1.3 Areal extent of sandy areas subject to physical disturbance 8.1.4 Length of coastline subject to physical disturbance due to the influence of manmade structures
	8.2 Integrity and diversity of coastal ecosystems, landscapes and their geomorphology are preserved	8.2.1 Change of land-use 8.2.2 Change of landscape Types 8.2.3 Share of nonfragmented coastal habitats

Annex III

The Indicator Core Set

Policyobjective[1]	N.[2]	Indicator	Description	ICZM Protocolreferringarticle	UNEP-MAP Ecologicalobjectives[3]
Preserve the wealth of natural capital in coastal zone	**1 (1)**	Distributional pattern of certain marine and coastal habitats under the Specially Protected Areas (SPA) Protocol	This indicator helps to describe the presence of relevant habitats according to the SPA Protocol of the Barcelona Convention. The indicator refers to Art. 4 of the SPA Protocol that addresses the coastal and marine ecosystems endangered or relevant because of scientific, aesthetic, cultural or educational interest. The area should fulfill at least one of the criteria of art. 8.2 (importance for conserving biodiversity, containing ecosystems specific to the Mediterranean area or endangered species, relevant because of scientific, aesthetic, cultural or educational interest).	6 (general principles of ICZM) a,b,c, 8 (protection and sustainable use of the coastal zone), 10 (specific coastal ecosystem),11 (coastal landscape),12 (islands) ,13 (cultural heritage)	1.4.1 Potential / observed distributional range of certain coastal and marine habitats listed under SPA protocol 1.4.2 Distributional pattern of certain coastal and marine habitats listed under SPA protocol
	2 (3)	State of the main commercial fish stocks by species and sea area	This indicator helps measuring changes in fish stock in order to identify human pressure on aquatic environment and plan fishing intensity	9 (economic activities)2b(fishing)	
	3 (4)	Effective management of protected areas: share of coastal and marine habitats and species listed under international agreements (SPA protocol) that are in good condition (favorable, unfavorable etc.)	This indicators help to describe the level of protection of relevant ecosystems that include specific species. The referring species are listed in the Annex II (endangered or threatened species) and Annex III (species whose exploitation is regulated) of the SPA Protocol	6 (general principles of ICZM) a,b,c, 8 (protection and sustainable use of the coastal zone), 10 (specific coastal ecosystem),11 (coastal landscape),12 (islands) ,13 (cultural heritage)	1.4.3 Condition of the habitat defining species and communities
Policyobjective	**N.**	**Indicator**	**Description**	**ICZM Protocolreferringarticle**	**UNEP-MAP Ecologicalindicators**

[1] Reference to the ICZM protocol- art.6 general objectives of ICZM

[2] In parenthesis the referring number of the complete indicator list available on the PEGASO Intranet

[3] Reference to the UNEP(DEPI)/MED WG 363/7/Corr.1 Draft decision on implementing MAP Ecosystem Approach roadmap: MediterraneanEcological and Operational Objectives, Indicators and Timetable for implementing the ecosystem approach roadmap

To formulate land-use strategies, plans, and programmes covering all coastal and marine uses	**4 (15)**	A governance system and legal instrument in support of Marine Spatial Planning is in place. (Yes / No)	This indicator gives description of the presence of institutions or agencies in charge of the development and implementation of marine spatial planning strategies by means of suitable legal instruments	6 (general principles of ICZM) f, 18 (national coastal strategies, plans and programmes), 20 (land policy)	
	5 (18)	There are spatial development plans which include the coastal zone but do not treat it as a distinct and separate entity.	This indicator helps to determine whether the coastal area is addressed with specific planning tool	6 (general principles of ICZM) f, 18 (national coastal strategies, plans and programmes), 20 (land policy)	
To give priority to public services and activities requiring the proximity to the sea, and to take into account the specific characteristics of the coastal zones when deciding about coastal uses	**6 (19)**	Economic production per sector (turnover)	The indicator is a description of the relative importance of one sector of the marine economy relative to another sector (generally in comparison to their relative importance to the total economy of the management area).	9 (economic activities), 9.1e	
	7 (20)	Employmentstructure	This indicator gives a description of the employment by economic activity, employment status and place of work	9 (economic activities)	
	8 (21)	Percentage of economic activities area in the coastal area	this indicators gives an idea of the intensity of the coastal activity	9 (economic activities)	
	9 (22)	Valueadded per sector	This indicator reflects the creation of wealth of each coastal sector.	9 (economic activities)	
	10 (37)	Land use flows: The area of new developments and its share on previously developed and undeveloped land in the coastal zone	This indicator describes the trend of the coastal land use during time helping to understand if, where and how urban sprawl occurred.	6 (general principles of ICZM)h	8.2.1 Change of land-use
Policyobjective	**N.**	**Indicator**	**Description**	**ICZM Protocol referring article**	**UNEP-MAP Ecological indicators**

To have a balanced use of coastal zone, and avoid urban sprawl	**11 (38)**	Area of built-up space in the coastal zone (both the emerged and submerged area of the coastal zone)	This indicator gives a description of the coastal area subject to the construction of facilities and infrastructures.	6 (general principles of ICZM) e; 9(economic activities) f	
	12 (39)	Waterefficiencyindex	This index allows the monitoring of progress in terms of the water saved as a result of demand management by reducing loss and wastage during both the transport and use of water. It is subdivided into total and sectoral efficiency (drinking water, agriculture and industry).	9.1.c (economic activities)	
	13 (41)	Changes in size, density, and proportion of the population living on the coast	This indicator describes the trend of population flow and number in the coastal zone compared to the inland.	6 (general principles of ICZM)h	
To perform Environmental Impact Assessment for human activities and infrastructures	**14 (44)**	Bathingwaterquality	This indicator gives a description of the quality of the bathing water according to specific parameters.	16 (monitoring activities and observation mechanism and network), 19 (environmental assessment)	
	15 (46)	Number of hypoxia events or extent of hypoxic areas	This indicator gives information about the occurrence of oxygen depletion in coastal waters due to events like eutrophication.	16 (monitoring activities and observation mechanism and network), 19 (environmental assessment)	
	16 (52)	Trends in the amount of litter washed ashore and/or deposited on coastline	This indicator can give a description of the quality of the shore depending on the presence of litter.	9 (economic activities) c (waste management)	10.1.1 Trends in the amount of litter washed ashore and/or deposited on coastlines, including analysis of its composition, spatial distribution and, where possible, source

Policyobjective	N.	Indicator	Description	ICZM Protocol referring article	UNEP-MAP Ecological indicators
To prevent damage to coastal environment, and appropriate restoration if damage already occurred	**17 (58)**	Areal extent of coastal erosion and coastal instability	This indicator can give a description of the vulnerability of the coastal zone to events that can cause erosion and instability of the coastline.	6 (general principles of ICZM),23 (erosion)	
	18 (61)	Areal extent of sandy areas subject to physical disturbance (beach cleaning by mechanical means, sand mining and beach sand nourishment)	This indicator gives a description of the coastal area subject to physical disturbance caused by human activities.	9 (economic activities) e	
	19 (62)	Risk assessment: economic assets at risk of storm surges and coastal flooding (considering sea level rise scenario's and return periods of storm surges)	This indicator gives information about the economic assets under risk of natural extreme events.	6j (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	
	20 (63)	Risk assessment: biological diversity (habitats/species) at risk of storm surges and coastal flooding (considering sea level rise scenario's and return periods of storm surges)	This indicator gives information about the natural resources under risk of natural extreme events	6 (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	
	21 (64)	Risk assessment: Population living in the at risk area of storm surges and coastal flooding (considering sea level rise scenario's and return periods of storm surges)	This indicator gives information about the population possibly harmed by risk of natural extreme events	6 (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	

Policyobjective	N.	Indicator	Description	ICZM Protocol referring article	UNEP-MAP Ecological indicators
	22 (65)	Productive and protected areas lost due to siltation, saltwater intrusion	This indicator helps to check if there is a loss in productivity or biodiversity due to specific sea water impacts in coastal zones	6 (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	
	23 (66)	Sea surfacetemperature	This indicator gives a description of the trend of the sea surface temperature	6j (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	
	24 (67)	Sea Level rise (including SLR relative to land cfr land subsidence)	This indicator gives information about the local sea level rise resulting from local subsidence and the level of the sea	6j (general principles of ICZM) 22 (natural hazards), 23 (coastal erosion), 24 (response to national disasters)	

The ICZM protocol articles considered in the core indicators are listed below (the non considered articles are in red). The overall PEGASO task 4.1 considers the ICZM Protocol article 27 EXCHANGE OF INFORMATION AND ACTIVITIES OF COMMON INTEREST, in particular the comma 2(a) “define coastal management indicators, taking into account existing ones, and cooperate in the use of such indicators”.

Article 6	**GENERAL PRINCIPLES OF INTEGRATED COASTAL ZONE MANAGEMENT**
Article 7	**COORDINATION**
Article 8	**PROTECTION AND SUSTAINABLE USE OF THE COASTAL ZONE**
Article 9	**ECONOMIC ACTIVITIES**
Article 10	**SPECIFIC COASTAL ECOSYSTEMS**
Article 11	**COASTAL LANDSCAPES**
Article 12	**ISLANDS**
Article 13	**CULTURAL HERITAGE**
Article 14	**PARTICIPATION**
Article 15	**AWARENESS-RAISING, TRAINING, EDUCATION AND RESEARCH**
Article 16	**MONITORING AND OBSERVATION MECHANISMS AND NETWORKS**
Article 17	**MEDITERRANEAN STRATEGY FOR INTEGRATED COASTAL ZONE MANAGEMENT**
Article 18	**NATIONAL COASTAL STRATEGIES, PLANS AND PROGRAMMES**
Article 19	**ENVIRONMENTAL ASSESSMENT**
Article 20	**LAND POLICY**
Article 21	**ECONOMIC, FINANCIAL AND FISCAL INSTRUMENTS**
Article 22	**NATURAL HAZARDS**
Article 23	**COASTAL EROSION**
Article 24	**RESPONSE TO NATURAL DISASTERS**
Article 25	**TRAINING AND RESEARCH**
Article 26	**SCIENTIFIC AND TECHNICAL ASSISTANCE**
Article 27	**EXCHANGE OF INFORMATION AND ACTIVITIES OF COMMON INTEREST**
Article 28	**TRANSBOUNDARY COOPERATION**
Article 29	**TRANSBOUNDARY ENVIRONMENTAL ASSESSMENT**

ANNEX IV

The questionnaire

1) The questions refer to the PEGASO set of ICZM indicators that can be found in task 4.1 folder on PEGASO intranet
2) with this questionnaire we want to capture the practical "hands-on" experiences of those who used/tested/calculated one or more of the indicators listed in the PEGASO set, even if the(se) indicator(s) we applied in a different policy context or purpose.

For the sake of clarity in the questionnaire: we make use of different terms like apply, test, calculate, and use indicators.
Use= Test (experimental phase) and then apply (more formal phase)
Testing includes calculating and data handling
Applying is needed in order to evaluate concept (definition, relevance within policy framework, sustainability criteria)
Calculating is needed in order to evaluate output (robustness, availability, appropriateness of data, etc….) and needs data and calculation method

USE AND EFECTIVENESS OF INDICATORS: feedback Questionnaire

For each of the indicators used, please complete the following questionnaire. The aim of this questionnaire is to assess the relevance of the PEGASO indicators set. Your feedback is essential to achieve a final set of relevant and useful indicators. If you tested/applied a particular indicator at different scales, please fill in two separate questionnaires for this indicator.

Q1	**Name and number of the indicator:**	_____
Q2	At which scale was the indicator tested/applied ? (oneanswer per questionnaire)	☐ local ☐national ☐ regional
Q3	Where did you test/apply the indicator (name of the region, country, county, territorial waters, Exclusive Economic Zone…?)	_____ - _____
Q4	Which ICZM policy objective or which policy framework did you want to assess with this indicator?	_____ _____
Q5	Was the indicator easy to calculate	☐ we did not succeed in calculating the indicator (go to question n°6) ☐ we succeeded in calculating the indicator although with some degree of difficulty (go to question n°7) ☐ the indicator was easy to calculate (go to question n°7) ☐ the indicator was already calculated in existing database. Which database did you use? (ex: FAO, etc.)_____ (go to question n°7)
Q6	If you did not succeed in calculating indicator, it was due to:	☐ a lack of available, reliable, appropriate data to calculate the indicator A lack of data at a relevant temporal or spatial scale ☐ the methodology to calculate the indicator is too complex or complicated, or not robust/reliable enough

		☐ ☐other (detail): _____ ___
Q7	If you succeeded in testing/applying the indicator, did you think	☐it was very useful to assess the ICZM objective ☐it was useful to assess the ICZM objective ☐it was not really useful to assess the ICZM objective ☐it was not useful at all to assess the ICZM objective If not useful at all, why not.....
Q8	Did you make cross-linkages between this indicator and other indicators?	☐ Yes. With which one? (go to question n°9) _____ ☐ No. Why? _____ (go to question n°10)
Q9	Did cross-connection between indicators help you to identify cause-effect phenomenon within the DPISR framework?	☐ Yes. Give short overview of the results _____ _____ ☐ No. Whynot? _____ _____ _____
Q10	In the end, did you succeed in assessing the mentioned ICZM policy objective (thanks to the mentioned indicator but also other indicator)?	☐ Yes ☐ No If not, what amendments would be required to the indicator formulation/calculation methods in order to improve its relevance or usefulness

ANNEX V

Indicators Methodological Factsheets

The methodological factsheets are available and downloadable from the PEGASO (www.pegasoproject.eu) website.

Indicators	Web link
1 Addedvalue per sector	http://www.pegasoproject.eu/links-9
2 Area of built-up space	http://www.pegasoproject.eu/links-9
3 Bathingwaterquality	http://www.pegasoproject.eu/links-9
4 Commercialfish stocks	http://www.pegasoproject.eu/links-9
5 Coastal and marine litter	http://www.pegasoproject.eu/links-9
6 Economicproduction	http://www.pegasoproject.eu/links-9
7 Employment	http://www.pegasoproject.eu/links-9
8 Erosion and instability	http://www.pegasoproject.eu/links-9
9 Natural capital	http://www.pegasoproject.eu/links-9
10 Hypoxia	http://www.pegasoproject.eu/links-9
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