ENI CBC MED Programme 2014-2020

Thematic Objective B.4 - Environmental protection, climate change adaptation and mitigation.
Thematic Priority B.4.4 - Incorporate the Ecosystem-Based management approach to ICZM into local development planning.

MED4EBM - Mediterranean Forum For Applied Ecosystem-Based Management

Technical and methodological references and operational framework for the execution of WP3 and WP4.

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Content

1 - BACKGROUND

1.1 - The Mediterranean Forum For Applied Ecosystem-Based Management (MED4EBM) project

The Mediterranean Forum For Applied Ecosystem-Based Management (MED4EBM) initiative is a partenrship project funded by the ENI CBC MED Programme 2014-2020, under the Thematic Objective B.4 (Environmental protection, climate change adaptation and mitigation) and Thematic Priority B.4.4 (Incorporate the Ecosystem-Based management approach to ICZM into local development planning). MED4EBM duration is three years and its total budget is 3,310,237.60 Euro; the project partnership spans four countries, as outlined here below:

ITALY
- AdT: Amici della Terra ONLUS - Ente Gestore Riserve naturali del Lago di Tarsia e della Foce del fiume Crati.
- PROGES - Progetti di Sviluppo - s.r.l..

JORDAN
- UNDP: United Nations development programme, Jordan Country Office.
- JREDS: Royal Marine Society of Jordan.

LEBANON
- TCNR: Tyre Coast Natural Reserve.

TUNISIA
- INSTM: Institut National des Sciences et Technologie de la Mer.

The Project aims at enhancing capacities of various stakeholders and institutional actors involved in the management of coastal and marine areas, and at establishing a cooperation and coordination platform for them to effectively implement ecosystem-based Integrated Coastal Zone Management (EB-ICZM). Governments and other ICZM stakeholders can use this platform to take informed decisions on planning and managing coastal resources and achieve effective coordination on the ground. In turn, this will help wide-spreading EBM in the Mediterranean consistently with the Barcelona Convention and its ICZM Protocol.

MED4EBM proposes the use of innovative tools to tackle the main issues which currently limit the widespread incorporation of EBM into ICZM processes (EB-ICZM). These are related to the difficulties that the decision-makers and the professional team involved still face because EB-ICZM require:

(1) intense and continuous efforts to coordinate management actions across a wide array of stakeholders (e.g. governmental agencies; international programs and projects; social and economic associations) and application sectors (e.g. fisheries, tourism, transport, biodiversity conservation);
(2) intensive work by the team of professionals implementing EB-ICZM, with particular reference to adjusting the available guidelines to the specificities of the relevant ecological and socio-economic systems, as well as in operationalising them for their effective application in area of interest;
(3) significant amount of data and large databases.

MED4EBM intends breaking the above-mentioned barriers using an innovative land and sea management package which makes EB-ICZM much easier for the professional team, the stakeholders and the decision-makers involved. This package has been developed by PROGES and named Integrated Spatial Planning (PROGES-ISP), consists of a software application and a set of methodological tools, to plan, implement and monitor EBM through a participatory and evidence-based approach.

The said methods allow handling the EB-ICZM multi-stakeholders analytical processes through a straight-forward path, providing analytical methods based on deterministic rather than statistical ecological and socio-economic assessments. These methods help the planning team and relevant stakeholders to identify and quantitatively assesses the relationships between ecosystem components, functions and services,

along with the associated human activities, toward the establishment of a multi-stakeholders ICZM scheme. The software package enables the analysis of spatial and tabular datasets, and the compilation of data-aware advanced reports, via a multi-windows interface which facilitates the browsing of large datasets through an ecosystem-based logical mapping framework.

MED4EBM official starting date is October 3rd 2019; however actual implementation activities couldn't start till mid June 2020, when the pre-financing funds was actually transferred to all partners.

1.2 - MED4EBM Work Packages 3 and 4 (WP3 and WP4)

MED4EBM deployment is organized in six Work Packages (WPs) as follows:

- WP1: Management,
- WP2: Communication,
- WP3: EBM-DSS: establishing effective management protocols and tools,
- WP4: Development of an Ecosystem-Based ICZM governance protocol in each of the Project target areas,
- WP5: Capacity and competence building,
- WP6: Capitalization of results: the Mediterranean Centre for disseminating EBM tools and methods.

With reference to MED4EBM core pursuits described in Section 1.1, WP3 and WP4 focus the establishing the above mentioned EB-ICZM cooperation and coordination platform in each of the project's target areas using the PROGEs-ISP package.

More specifically, WP3 aims at establishing one Ecosystem-based ICZM Decision Support Systems (EB-ICZM-DSS) in each of the project's target areas by using the PROGEs-ISP package mentioned in Section 1.1. To this end, the PROGES-ISP methodological protocol will be applied which consists of five easy-to-apply sequential steps to handle the complex multi-stakeholders analytical processes that characterize EB-ICZM applications. This protocol adopt simple deterministic ecological assessments, as opposite to the complex statistical and/or algorithmic approaches currently used in ecosystem based management applications. It identifies and quantitatively assesses the relationships between ecosystem components, functions and services, as well as the associated human activities to establish a multi-stakeholders EB-ICZM scheme. The application of this protocol is associated with the use of the PROGES-ISP software for the analysis of spatial and tabular datasets, as well as the compilation of data-aware advanced reports via a multi-windows interface.

The EB-ICZM-DSS resulting from WP3 will be used in WP4 to perform a systemic, indicator-based, and participatory analysis to develop an EB-ICZM Governance Protocol (EB-ICZM-GP) for each of the MED4EBM target areas. Using the EB-ICZM-DSS will ensure that: (1) each human activity is managed in the context of ALL the ways it interacts with marine and coastal ecosystems, and (2) multiple activities are being managed for a common outcome. The backbone of each the EB-ICZM-GPs will be jointly drafted by local actors and stakeholders, being their active engagement in the planning and management process the key to the success of EB-ICZM applications. This joint drafting will be executed by applying a specific methodology, which identifies in a systematic manner all the significant cause-effect relationships between the different components of the local socio-ecological ICZM dynamics. These cause-effect relationships are then objectively assessed using the EB-ICZM-DSS of WP3 to establish the EB-ICZM-GPs to implement flexible management schemes and improve their responsiveness to monitoring results, so as to actually achieve adaptive and effective EB-ICZM.

PROGES will coordinate WP3 and WP4, making available and guiding the project's partners in applying the said protocol and use the ISP software. UNDP facilitate the liaison between partners to ensure the coordinated operational deployment of the various on-the-ground tasks for the implementation of WP3. JREDS, AdT, TCNR and INSTM will organize, lead and implement all the activities for the tailor-making of the

EB-ICZM-DSS executed in their respective target areas, including the liaisons for the active involvement of relevant stakeholders, the definition of context-specific indicators and the related data collection.

Technical and methodological references for the execution of WP3 and WP4 are illustrated in the following sections of this document, together with the base operational framework to plan and execute inception activities toward the actual launching of WP3 and WP4.

2 - TECHNICAL AND METHODOLOGICAL REFERENCES FOR THE EXECUTION OF WP3 AND WP4

2.1 - Ecosystem Based Integrated Coastal Zone Management (EB-ICZM)

United Nations Environment defines Ecosystem Based Management (EBM) in coastal and marine zones as an approach that goes beyond examining single issues, species, or ecosystem functions in isolation [UNEP 2011]. Instead EBM recognizes ecological systems for what they are: a rich mix of elements that interact with each other in important ways (Fig. 2.1). EBM strategies therefore require an interdisciplinary approach that balances ecological, social and governance principles, incorporating data analysis of various interactions at appropriate temporal and spatial scales in a distinct geographical area [Arkema et al. 2006; Long et al. 2015].

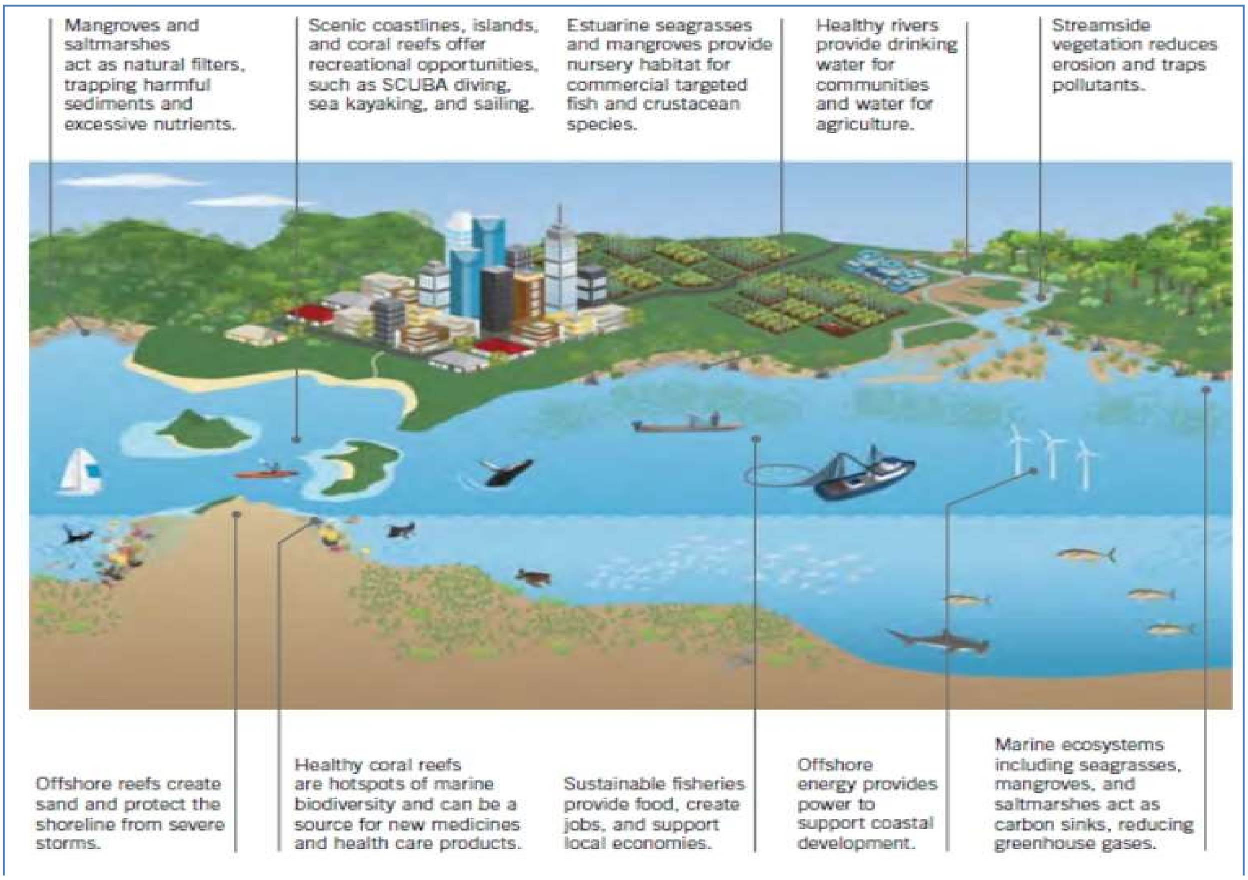

Fig. 2.1 - EBM in coastal and marine zones

EBM started to be used in marine and coastal environments since the '90s [Grumbine 1994], as an alternative way to manage the resources and try to reduce overexploitation and degradations of marine ecological systems. Since then, EBM scientific references and planning guidelines have been developed and are indeed available in literature, such as in [Arkema et al. 2006; Long et al. 2015; UNEP 2011]. Nevertheless, attaining effective and comprehensive EBM is still quite often seen as a daunting and complicated challenge by either manager and/or practitioners and, some time, also by higher-level decision

makers [UNEP 2011]. Under its Thematic Objective "Environmental protection, climate change adaptation and mitigation" (B.4), the ENI CBC MED Programme 2014-2020 has therefore identified one of its Thematic Priorities (B.4.4) as to "Incorporate the Ecosystem-Based management approach to ICZM into local development planning", by improving intra-territorial coordination among different stakeholders and supporting spatial planning and implementation capacities of involved institutions to establish effective Ecosystem-Based Integrated Coastal Zone Management (EB-ICZM) schemes, as well as exchanging of experiences and best practices across Mediterranean Countries.

EBM requires efforts to constantly guarantee the coordination of the management actions across multiple institutions and at different geographical scales [Leslie et al 2015]. Moreover, since EBM doesn't have a universal application framework, it has to be adapted to every specific area through different experimental management approaches [Aswani et al 2012; Long et al 2015]; this makes each case of EBM application highly demanding for the planning team and, at times, may also lead to some confusion among the management players [Long et al 2015]. Finally, effective EBM applications must be built on significant amount of data and, thus, require extensive data collection and the handling of large datasets, characteristics indicated as not always suitable for developing countries [Leslie et al 2015].

One of the most critical elements of success for an EBM process is the active involvement of the appropriate stakeholders. This entails that people with various education level and experience background interact to share their own knowledge and participate to the management debate. Scientific, technical, administrative and civil-society stakeholders may see the same reality from a significantly different point of view and, thus, their involvement in multi-sector integrated management planning processes often bring conflicts [Röckmann et al 2015]. At the same time, the participation of all the stakeholders ensures the essential role of recognizing the entire set of relevant social dynamics and ecological interactions, while uncovering the compatibility-potential of multiple uses of the same set of resources as well [Pomeroy and Douvere 2008].

In order for EBM policies to be crafted and implemented effectively, the stakeholders have to become able to explore potential alternative scenarios, to identify synergies, and to finally gain a collective system thinking [Schwilch et al 2012]. The challenge is therefore to develop, implement and disseminate procedures and tools that allow expressing in quantitative ways a system thinking [Murray et al 2016]. In this respect, Arkema et al (2006) suggested that "*tools for traditional, single-species management are available and widely used, but explicit approaches are still needed to successfully conduct EBM*".

In responding to the above needs MED4EBM promotes easy-to-apply operational methodologies that can help wide-spreading EB-ICZM in coastal and marine planning and management applications across the Mediterranean. EB-ICZM paradigm can become even easier to apply for the decision-makers, as well as fpr the professional team involved, if they also avail specifically-developed software tools for implementing Ecosystem Based Integrated Coastal Zone Management Decision Support System (EB-ICZM-DSS) platforms. In order to develop EB-ICZM-DSSs in its four target areas, MED4EBM will apply the methods and the software tools included in the PROGES-ISP package mentioned in Section 1.1; these methods and tools are illustrated in the next Section of this document.

2.2 - Ecosystem Based Integrated Coastal Zone Management Decision Support System (EB-ICZM-DSS)

2.2.1 - Overview

As anticipated in the previous sections, MED4EBM EB-ICZM-DSSs are built upon the PROGES-ISP package; this package includes two categories of instruments: an operational protocol for the execution of multi-disciplinary ecosystem-based environmental assessments and a software application linked to spatial and tabular databases for handling relevant ecological data and for preparing synoptic data-aware reports. The operational protocol implements EB-ICZM applications through the sequential execution of two multi-disciplinary analytical methods: the *Ecosystem Context Analysis* and the *System Cause-Effect Analysis*. In

turn, the PROGES-ISP software package allows for the synchronized integration of multi-windows environment, facilitating the ecosystem-based analysis of spatial and tabular datasets and the compilation of data-aware advanced reports.

2.2.2 - EB-ICZM-DSS analytical methods

At the beginning of an EB-ICZM project, meetings with relevant governmental and non-governmental organizations and the civil society are held in order to discuss and prepare the project implementation strategy, as well as to identify key stakeholders and potential partners. A survey to identify other relevant projects targeting similar conservation and resource-management objectives is also conducted. In this preliminary phase, relevant literature references and data sources start to be collated as an initial knowledge base for the EB-ICZM planning team, as well as for all other relevant stakeholders and actors involved.

The *Ecosystem Context Analysis* is a methodological tool providing straight-forward paths for multi-stakeholder analyses. It allows establishing and managing a participatory analytical process, which ensures an effective dialogue between stakeholders from the civil society, technical and/or scientific organisations, and administrative institutions toward reaching a common understanding of the relevant EB-ICZM context. This procedure is based on deterministic rather than statistical or algorithmic ecological assessments to identify and assess the relationships between ecosystem components, functions and services, along with associated human activities. To this end, a boxes-and-arrows system diagram describes the natural and human systems which underlie EB-ICZM scenarios by identifying their structural components (boxes) and their interactions (arrows). These systems are essentially constituted by: the biotic and abiotic components of the natural ecosystem, the services that ecosystems provide to sustain life, and the uses that human society makes of these services. Each of the diagram elements is in turn further characterized through a set of quantitative indexes and indicators. The construction of the system diagram follows a sequential three stages analytical process (Fig. 2.2) to guide relevant stakeholders in moving from a conceptual (system matrixes), through a qualitative-structural (system diagram), to a quantitative-structural (system diagram and indicators) practical representation of the biological, environmental and socio-economic systems at the basis of the EB-ICZM of the relevant spatial domain. This is typically achieved through a set of workshops, usually ranging from one to three depending on the complexity of the given management context.

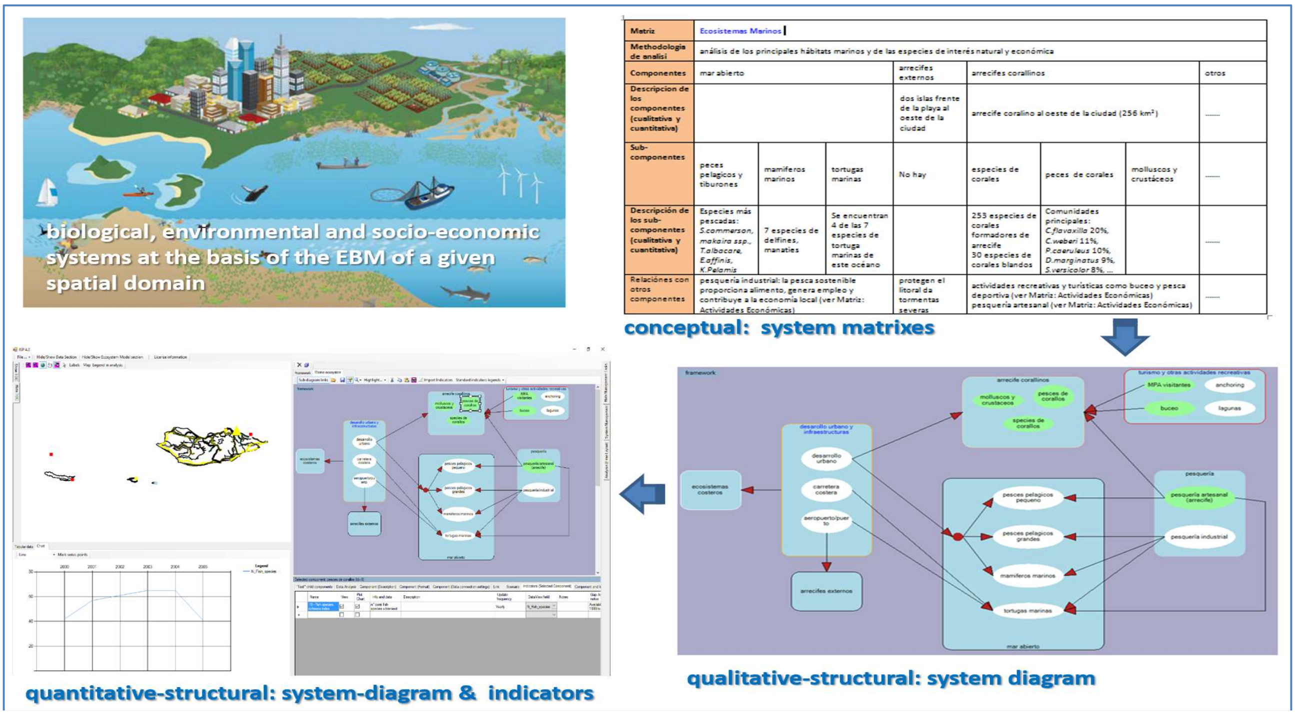

Fig. 2.2 - Sketch of the *Ecosystem Context Analysis*

The first step of this process includes the identification of major characteristics of the area. This exercise helps the EB-ICZM planning team to break the reality down in several management sectors, such as natural resources, agriculture, tourism, fishery and so on. The analysis also includes the identification of the main services provided by the ecosystems of the focused area. The description of each single sector is developed in a set of system matrices, or tables where all the components are listed and illustrated, with components possibly comprising one or more sub-components. For example, a system matrix focusing the coastal and marine ecosystem sector of a given EB-ICZM application could include the components that give a synoptic representation of such sector (e.g. wetlands, karstic system, beaches and sand dunes, rocky coast, coral reef and marine prairies). The sub-components that further describe the wetland could, in turn, be: mangroves, coastal lagoons and estuaries; similarly, the marine prairies component may include mixed-prairies, single-species dominated prairies, sandy sea bottom and rocky sea bottom as sub-components. The system matrix also includes a brief description of all the components and sub-components there listed, with circumstantial or local information included if available. Otherwise the description, albeit more generic, would still serve as a record of the common view that the EB-ICZM planning team has developed on the actual socio-ecosystem realities that the various components represent. The last analytical item to be included in the system matrix is a brief description of the key ecological or social mechanisms which regulate the interaction between the components and sub-components identified in the very matrix; an example of interactions could be the influence of the karstic system on the water quantitative and qualitative parameters of the wetland component.

In the second analytical step, the EB-ICZM planning team further develops the collective understanding of the EBM scenario described in the system matrices and transposes it into a diagram. All the components and sub-components defined in each of the matrices are initially drawn in a system diagram as box items; the hierarchical structure of components and related sub-components is represented by drawing the boxes representing the latter into those representing the previous. Once all components and sub components of the matrix have been drawn in the system diagram, the information reported in the matrix to describe the interactions between the components and sub-components is used to draw the initial set of links (arrows) between relevant components (boxes) of the diagram. At this stage of development, the system-diagram is not providing any additional information other than that already included in the system-matrix. However, this new diagrammatic representation of the same information can help to identify possible inconsistencies and/or incompleteness of the model, either in the definition of components and sub-components (the "structure" of the system being studied) or in their interconnections (the dynamics of the given system, that is the way different components interact). The EB-ICZM planning team can then work to adjust this basic diagram to solve inconsistencies and remove incompleteness, through a step-by-step iterative process leading to the construction of a strong-structured system diagram modelling the biophysical and human system at the basis of the given EB-ICZM application. Detailed methods and examples are available to guide in the execution of this task [PROGES 2009]. The third and final step of the *Ecosystem Context Analysis* is for the EB-ICZM planning team to develop a set of quantitative indicators to characterize each component and sub-component of the system diagram. Information and data from technical report, scientific papers as well as from any other appropriate source are collected and analysed to quantify chosen indicators. For example, one of these indicators for the characterization of the system diagram component "coral reef habitat" could be the richness of coral fish species trend.

The *System Cause-Effect Analysis* is a straight forward procedure that systemically analyses all the components of the system diagram (resulting from the *Ecosystem Context Analysis*) to the define an integrated set of management measures coherent with the principles of EB-ICZM. This analysis considers systematically pairs of components of the system diagram to: i) assess the conservation and/or development status of the pair's components and their interaction; ii) estimate the current level of use, of overexploitation, or of untapped-potential of the relevant ecosystem services; iii) use these assessments and estimates to identify management measures targeted to the sustainable use of the ecosystem services.

Following this procedure, each management measure responds to the conservation and/or sustainable development needs of the two system components to which it is associated, including ensuring sustainability to the socio-ecological interaction between the very pair of components. When moving to the following step of the analysis, i.e. to that of other pairs of components to identify a new management measure, possible side-effects of the previous measure are inevitably considered when the analysed pair includes one of the two components of the previous pair. The above ensures that the resulting set of management measures is coherent with the changes in management practice requested in [UNEP 2011] for effective EB-ICZM: *(1) each human activity is managed in the context of ALL the ways it interacts with [marine and coastal] ecosystems, and (2) multiple activities are being managed for a common outcome.*

2.2.3 - EB-ICZM-DSS software application

The PROGES-ISP software package [PROGES 2009] used to implement the MED4EBM EB-ICZM-DSS, is a user-friendly Microsoft Windows application that can support the implementation of several planning and management pursuits, such as: Sustainable Development; Ecosystem Based Management; biodiversity conservation; planning and management of protected areas; rehabilitation and restoration of degraded land areas; adaptation to climate changes; risk assessment and management of natural disasters; land use planning; management of infrastructural networks (e.g. water, transportation, roads, agricultural & industrial facilities); waste management; urban development planning. The main window of the software (Fig. 2.3) shows maps, tables or charts, system diagrams, and a space for notes, comments or a report draft. It gives the opportunity to visualise different kind of data and information with the view to compare the various system components targeted by a possible management action. The software also includes a tool (*hyperlink*) that automatically links the name of the components in a report to the components shown in the DSS, as well as their related maps, tables or charts, in order to support the decision-making process.

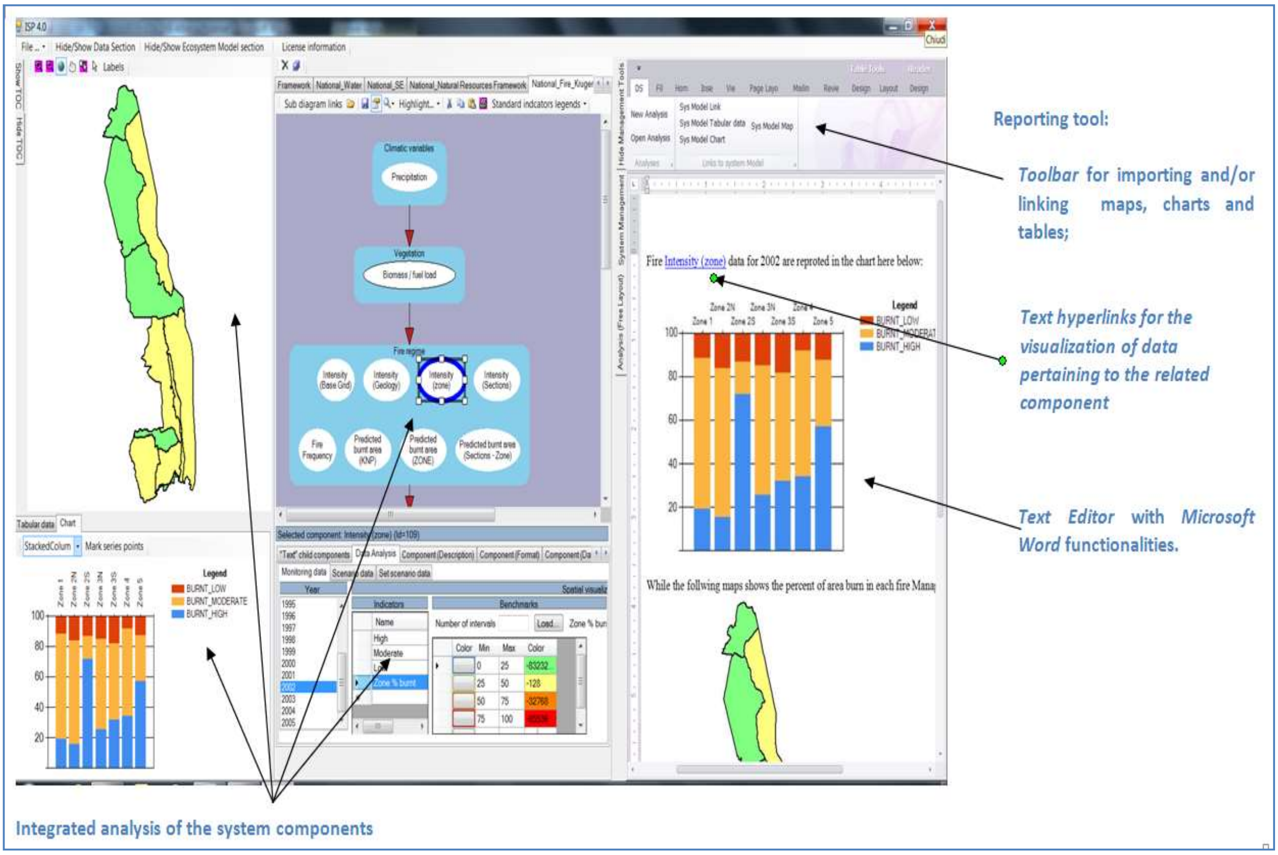

Fig. 2.3 - The PROGES-ISP software package

2.3 - Ecosystem Based Integrated Coastal Zone Management Governance Protocol (EB-ICZM-GP)

The set of management measures resulting from the *System Cause-Effect Analysis* are then mainstreamed into existing plans of relevant sector institutions and management authorities toward the establishment of an effective multi-level ICZM governance protocol (EB-ICZM-GP) in the four areas targeted by MED4EBM.

MED4EBM partners will liaise and support the said local actors in designing and implementing initiatives aimed at implementing the said measures. This liaison will be extremely facilitated by the process put in place through WP3 and WP4 to develop the very measures through a collective effort of the said stakeholders. Indeed, throughout the execution of the above described methods that has led to the development of the EB-ICZM measures, it can be said the these are not developed "by MED4EBM" but "through MED4EBM" (by the concerned public institutions and relevant stakeholders). This specification is not a mere semantic exercise but has crucial consequences on the ownership of MED4EBM development contributions by its beneficiaries. Indeed, no external project, technical support or consultancy can ensure that a new management/governance protocol is adopted and applied by the concerned public authorities, nor that this is embedded in relevant laws/regulations (the drafting and approval of which implies a thorough political process). On the contrary, if the very management/governance protocols are directly developed by the concerned public authorities with the active involvement of the relevant stakeholders (i.e. the groups having interest in the array of resources affected by the new governance protocol), these public authorities will definitely adopt the said protocols (they have developed them), and will also spare no effort to have them embedded in relevant laws/regulations be the competent political/legislative bodies. Also, the active involvement of the relevant stakeholders in the development of the governance protocol will ease the political/legislative process with reference to the building of the needed public consensus.

Analysing the entire process of developing the EB-ICZM-GP from a mere technical-scientific perspective, it emerges that the use of the *Ecosystem Context Analysis* and the *System Cause-Effect Analysis* methods reduces significantly the efforts needed to ensure the coordination of EB-ICZM actions across multiple institutions and sectors at different geographical scales. The system matrices and the system diagrams "force" stakeholders to analyse systemically relevant ecological and socio-economic dynamics; then, through the *System Cause-Effect Analysis*, the very stakeholders can assess systematically each elemental component of the said social and ecological systems. In turn, the arrows of the system diagram drive the stakeholders through a similar itemised assessment of social, economic and ecological interactions between these elemental components. This analytical pattern allows the stakeholders to decompose the complex EB-ICZM dynamics in a structured set of simple elements and, thus, to identify all possible relations, interactions or conflicts between them (Fig. 2.4). This work on a simple decomposed reality helps them to develop a common attitude and vocabulary toward EB-ICZM, thus removing one of the barriers identified in the literature as hampering communication among scientific communities, management agencies and the public involved in EB-ICZM application [Arkema et al 2006]. The *Ecosystem Context Analysis* and the *System Cause-Effect Analysis* methods have indeed been applied in a variety of ecosystems, and have always proven easy-to-apply and extremely effective in ensuring that all relevant stakeholders reach a common understanding and management view of how environmental, social and economic considerations fit together in ecosystem-based planning and management applications. EB-ICZM applications require significant investments in data collection, management and their retrieval in databases, characteristics that Christie et al (2007) considered as a limit when applying EB-ICZM in developing countries. However, the *Ecosystem Context Analysis* method reduces this investment to the minimum possible for a successful application. This because the assessment of data needs and relevant gap analysis are systematically executed against the specific set of objective indicators identified through the *Ecosystem Context Analysis*. In turn, the *System Cause-Effect Analysis* allows the identification of: i) the components which, in order to avoid hampering the effectiveness of the EB-ICZM application, must necessarily be assessed with quantitative indicators; ii) those components that, always safely, could be characterised by qualitative indicators. The PROGES-ISP software tools also make extremely efficient handling the large datasets that EB-ICZM requires.

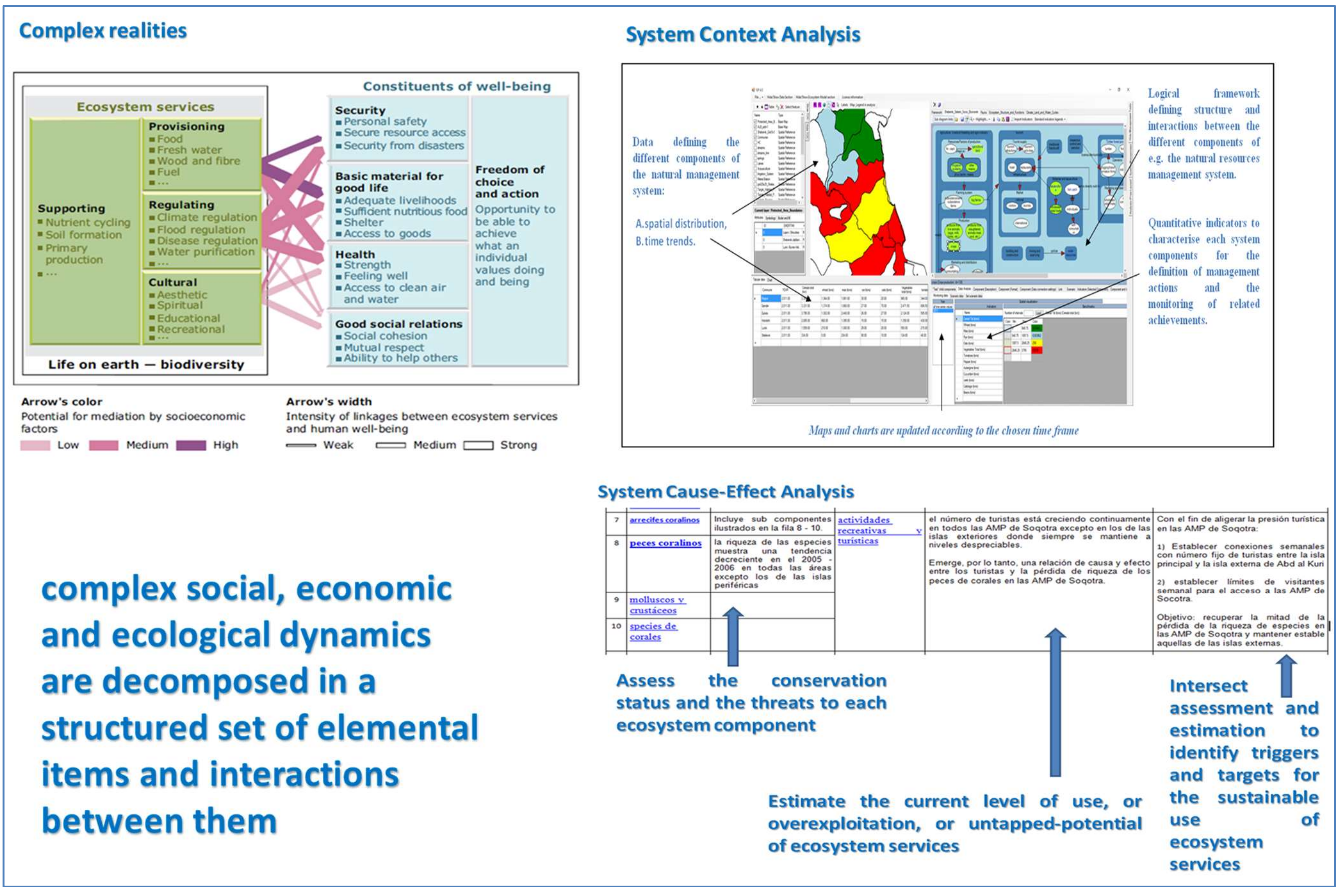

Figure 2.4 - Simplifying complex environmental, social and economic dynamics

3 - BASE OPERATIONAL FRAMEWORK FOR THE EXECUTION OF WP3 AND WP4

3.1 - Working Team

For the deployment of WP3 and WP4 an EB-ICZM Technical Team will be established by AdT, PROGES (WPs Leader) and UNDP:

- EBM Methodological Coordinator (PROGES);
- EBM Expert 1 (UNDP);
- EBM Expert 2 (AdT).

The EB-ICZM Technical Team will work in close coordination and collaboration with EB-ICZM Local Units established by AdT, INSTM, JREDS and TCNR for implementing WP3 and WP4 in the four MED4EBM target areas.

Terms of Reference (ToRs) for establishing these EB-ICZM Local Units by AdT, INSTM, JREDS and TCNR will by jointly developed as a result of WP3 and WP4 inception activities (Phase 1, Section 3.2).

3.2 - Operational phases, activities and outputs

The deployment of WP3 and WP4 *is organized* in five operational phases, as listed here below:.

Phase 1. Inception activities: Partner’s base training, thematic scoping and stakeholders analysis.

Phase 2. *Ecosystem Context Analysis*: recognizing connections within and across ecological and human systems spanning over the focused area.

Phase 3. Development of indexes and indicators for the quantitative assessment of EB-ICZM social, economic and ecological dynamics.

Phase 4. Data gathering and construction of tabular and GIS databases.

Phase 5. *System Cause-Effect-Analysis*: assessment of ecological risks and socio-economic stresses and identification of management interventions.

Phase 6. Mainstreaming EB-ICZM measures into local development plans.

The detailed illustration of how to deploy these six Phase is provided in the following of this section.

Phase 1. Inception activities: Partner's base training thematic scoping and stakeholders analysis

Objective and rationale

This Phase aims at defining the spatial and thematic scopes of the EB-ICZM application, as well as at identifying key stakeholders, potential partners and their roles in the project. This information help defining:

- the composition and job secretion of the working groups building up the EBM Local Units;
- preliminary needs in terms of training, hardware and software for the functioning of the EBM Local Units (WP5);
- initial planning for WP3 and WP3 implementation.

Outputs

Tangible outputs	**Intangible outputs**
a) A text table illustrating the thematic scope of the EB-ICZM application. b) A text table which defines roles and responsibilities of key stakeholders within the EB-ICZM planning team. c) Terms of Reference (ToRs) for establishing these EB-ICZM Local Units.	d) The main technical and operational elements to plan for the implementation of the EB-ICZM Protocol are identified and organized in simple reports.

Methods

Spatial and thematic scopes of the EB-ICZM project are defined with reference to two main typologies of application cases, as outlined here below:

- ⇨ a comprehensive EB-ICZM application focusing important ecosystems, such as those spanning over a given coastal zone or a marine protected area, and integrating all sectors that impact, or are impacted by, the said ecosystems (Fig. 3.1);
- ⇨ Managing a set of sector-specific sustainable development dynamics as part of an incremental EB-ICZM process. For example, regulating agriculture, aquaculture and fishing activities to avoid conflicts between users (e.g. agricultural and aquaculture drains may contaminate waters in estuaries and/or mangroves, reducing potential fishing catches) and unsustainable pressure to relevant ecosystems (degradation/destruction of habitats in relation to fishing techniques; overfishing (Fig. 3.2).This typology of EB-ICZM applications are usually simpler than a comprehensive EBM application and, as such, suits better for items at broader scales.

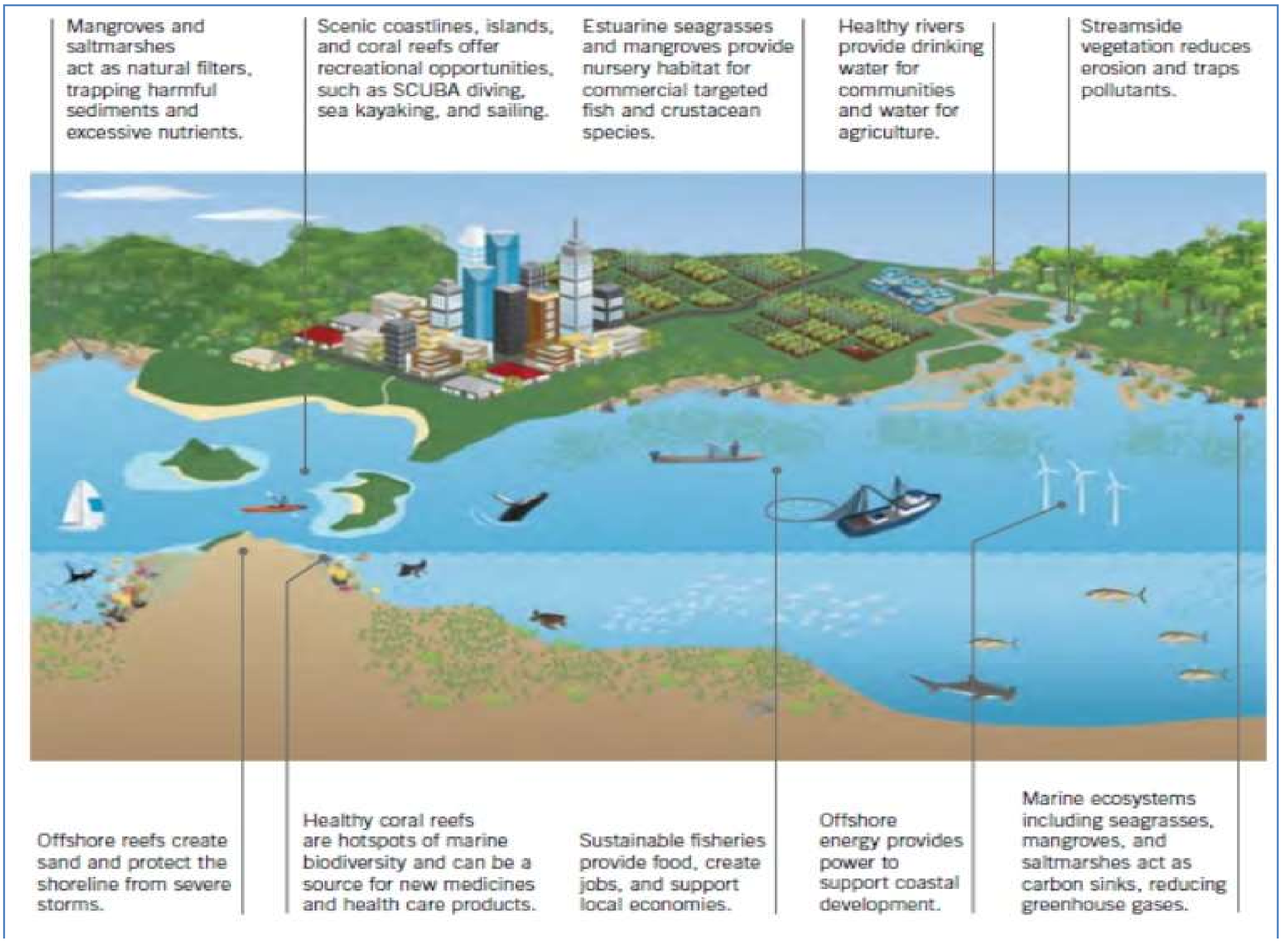

Fig. 3.1 - Comprehensive EB-ICZM: managing ecosystems spanning a given spatial domain

Fig. 3.2 - Incremental EB-ICZM: integrating two or more sectors within the relevant ecosystem processes

The gathering and collation of the information to define on the EB-ICZM application spatial and thematic scopes is guided by specially designed formats the will be provided by PROGES. Similar formats lso guide the identification and the roles of each the key governmental, non-governmental and civil society stakeholders within the EB-ICZM working group.

Operational arrangements

A training will be organized by PROGES to introduce methodological and software tools illustrated in this document to all Partners. Adapting to the new Covid-19 related situation, meetings will be executed using remote team-working-channels and webinar tools (Microsoft Teams). To the extent that this may be needed, and that travel may be possible/allowed, remote training may be complemented by in-presence session(s) with limited number of participants.

Partners will then organize and execute meetings with relevant civil society, governmental and non-governmental organizations are organized to gather the information needed to fill the above mentioned formats. Relevant literature references and data sources start to be collated with the aim of building a knowledge base for the EB-ICZM planning team as well as all for the other relevant stakeholders and actors involved in the EB-ICZM project. A survey to identify other relevant projects targeting similar conservation and resource-management objectives may also conducted.

Phase 2. *Ecosystem Context Analysis*: recognizing connections within and across ecological and human systems spanning over the focused area.

Objective and rationale

The *Ecosystem Context Analysis* is aimed at developing a structural model of the ecosystem components and services, the associated human activities, as well as the interactions between them. It recognizes the key connections within and across the ecological and the human systems spanning over the focused area, so as to provide a manageable framework for understanding how ecosystems, biodiversity and human activities inter-operate in EB-ICZM applications.

The *Ecosystem Context Analysis* is a methodological procedure providing straight-forward paths for multi-stakeholder analyses. It allows establishing and managing a participatory analytical process which ensures an effective dialogue between stakeholders from the civil society, the relevant technical and/or scientific organizations, and the concerned administrative institutions toward reaching a common understanding of the relevant EB-ICZM context. This procedure is based on deterministic rather than statistical or algorithmic ecological assessments, and leads to the identification and quantitatively assessment of the relationships between ecosystem components, functions and services, along with associated human activities. To this end, a boxes-and-arrows system diagram is drawn-up to describe the natural and human systems which underlie EB-ICZM scenarios by identifying their structural components (boxes in Fig. 3.3) and their interactions (arrows in Fig. 3.3). These systems are essentially constituted by: the biotic and abiotic components of the natural ecosystem, the services that ecosystems provide to sustain life, and the uses that human society makes of these services. Each of the diagram elements is in turn further characterized through a set of quantitative indexes and indicators (see Phase 3).

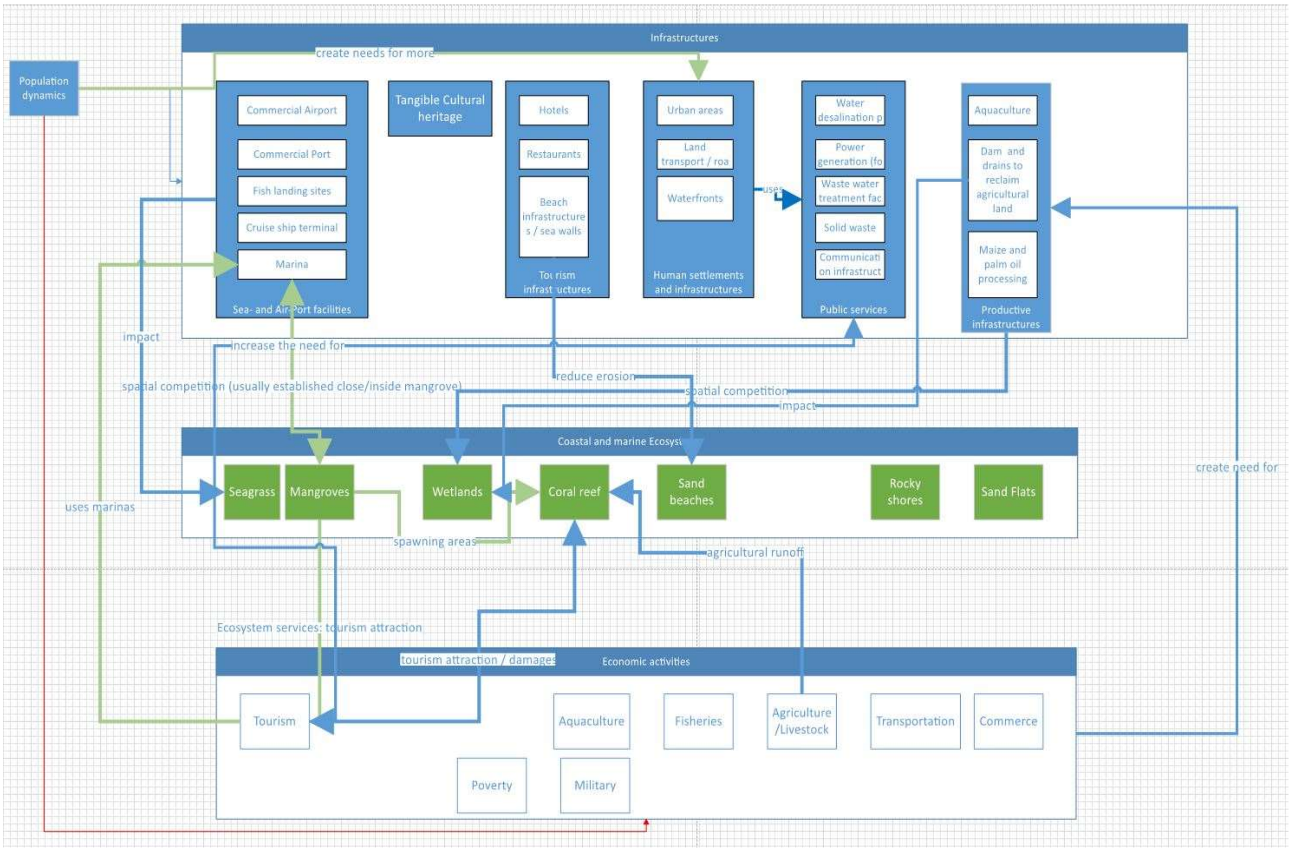

Fig. 3.3 – Example of system boxes-and-arrows diagram

<u>Outputs</u>

Tangible outputs	Intangible outputs
a) System Matrices (Fig. 3.5): tables listing all structural components of the relevant biophysical and human systems, together with their synthetic descriptions. b) System box-and-arrows Diagram (Fig. 3.6): describe the dynamics (arrows) between the biotic and abiotic components (boxes) of the natural ecosystem, the services that ecosystems provide to sustain life (boxes), and the uses that human society makes of these services (boxes).	c) Stakeholders 1. reach a common understanding and management view of how environmental, social and economic considerations fit together in EB-ICZM applications; 2. harmonize their initially different viewpoints within the EB-ICZM management planning processes; 3. develop a common outlook and a coherent vocabulary which improve the communication among scientific communities, management agencies and the public involved in EB-ICZM application.

<u>Methods</u>

The construction of the system diagram follows a sequential two stages analytical process (Fig. 3.4) to guide relevant stakeholders in moving from a conceptual (pictures and/or illustrations and/or sketches; system matrixes), to a structural (system box-and-arrows diagram) practical representation of the biological, environmental and socio-economic systems at the basis of the EB-ICZM of the relevant spatial domain. This is typically achieved through a set of workshops, usually ranging from one to three depending on the complexity of the given management context.

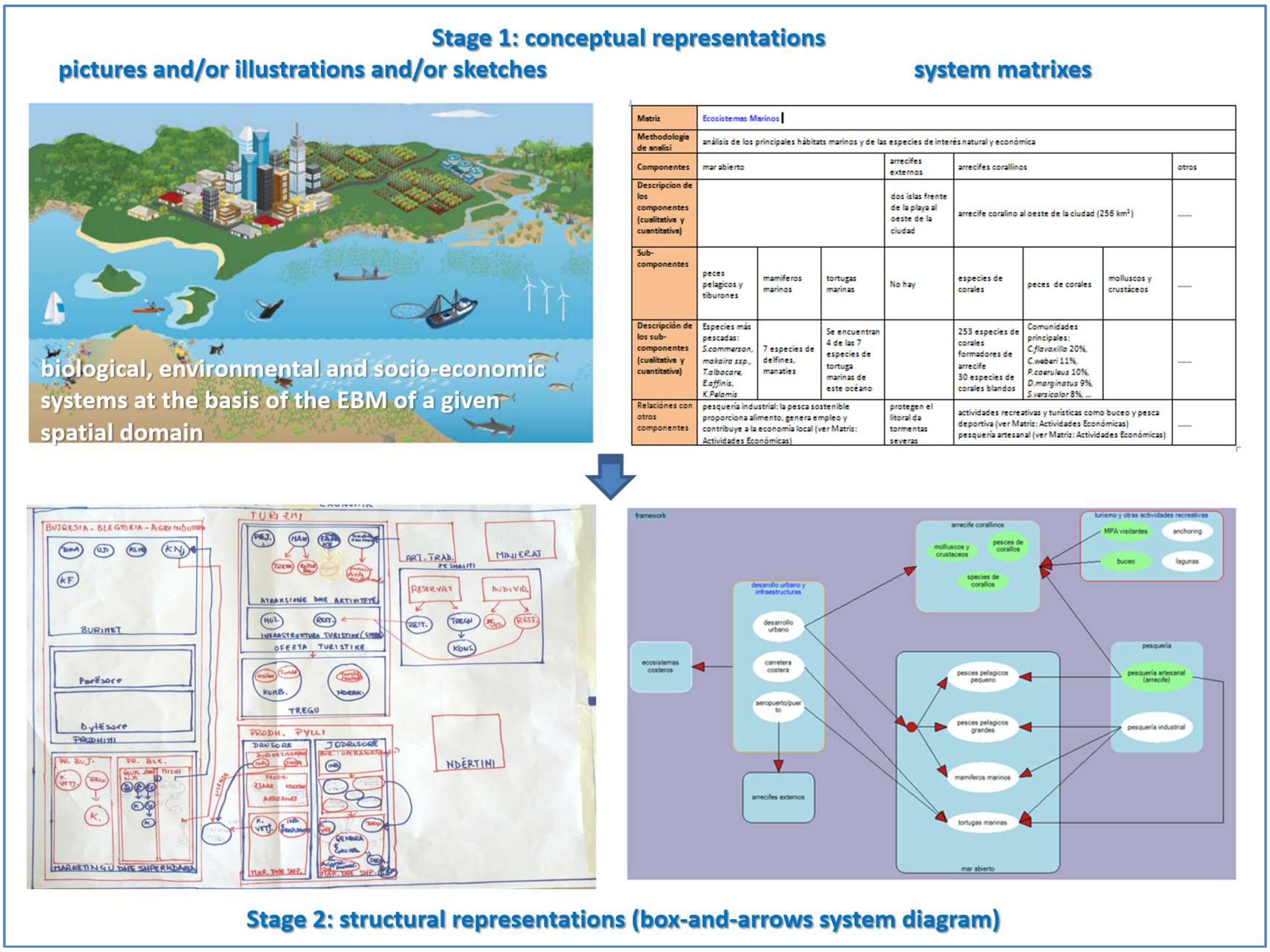

Fig. 3.4 - Construction of the system diagram: from conceptual to structural EB-ICZM model

This process starts with the identification of the major characteristics of the area. This exercise helps the EB-ICZM planning team to break the reality down in several management sectors, such as natural resources, agriculture, tourism, fishery and so on. The analysis also includes the identification of the main services provided by the ecosystems of the focused area. The description of each single sector is developed in a set of system matrices, or text-tables where all the components are listed and illustrated, with components possibly comprising one or more sub-components.

For example, a system matrix focusing the coastal and marine ecosystem sector of a given EB-ICZM application could include the components that give a synoptic representation of such sector (mangrove, wetlands, coral reefs, sand beaches, sea grass, rocky shores, and sand flats in the example of Fig. 3.5). The sub-components that further describe the mangrove could be: riverine, estuarine and fringing; similarly, the wetland component may include freshwater, brackish and saltwater as sub-components. The system matrix also includes a brief description of all the components and sub-components there listed, with circumstantial or local information included if available. Analytical items to be included in the system matrix also include a brief description of the key ecological or social mechanisms which regulate the interaction between the components and sub-components identified in the very matrix; an example of these kind of interactions could be that between mangrove forests, salt/brackish waters, and the relevant river system as illustrated in the first column of Fig. 3.5.

Matrix	Coastal Marine Ecosystem						
Metodología de análisis							
Components	Mangroves	Wetlands	Coral reefs	Sand beaches	Seagrass	Rocky shores	Sand Flats
Description of the components (qualitative and quantitative)	Coastal forest comprising any of the four species of the Mangroves (red, black, white, button)	Extension of land partially or permanently covered in water	Aggregations of coral polyps forming solid structure	Coastal predominantly sandy area	Underwater prairie	Coastal area with a predominantly rocky substrate	Sandy bottom, mostly absent of vegetation
Subcomponents	Riverine Estuarine Fringing	Freshwater Brackish saltwater	Crest Fringing Etc..	Sand dunes	Monospecific Mixed Blowout	Type (karstic, rubble, mixed) Slope (steep, moderate, gentle)	Grain size Thickness
Description of the subcomponents (qualitative and quantitative)	Riverine/mangrove forest associated with a river system Estuarine/mangrove forest present on brackish ecosystem Fringing/mangrove forest growing alongside the coastline Information of area percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact	Information of area, percentage composition spatial distribution and impact

Fig. 3.5 - Example of System Matrix

In the second analytical stage of the *Ecosystem Context Analysis*, the EBM planning team further develops its collective understanding of the EBM scenario described in the system matrices and transposes it into a diagram (Fig.3.6). All the components and sub-components defined in each of the matrices are initially drawn in a system diagram as box items; the hierarchical structure of components and related sub-components is represented by drawing the boxes representing the latter into those representing the previous. Once all components and sub-components of the matrix have been drawn in the system diagram, the information reported in the matrix to describe the interactions between the components and sub-components is used to draw the initial set of links (arrows) between relevant components (boxes) of the diagram.

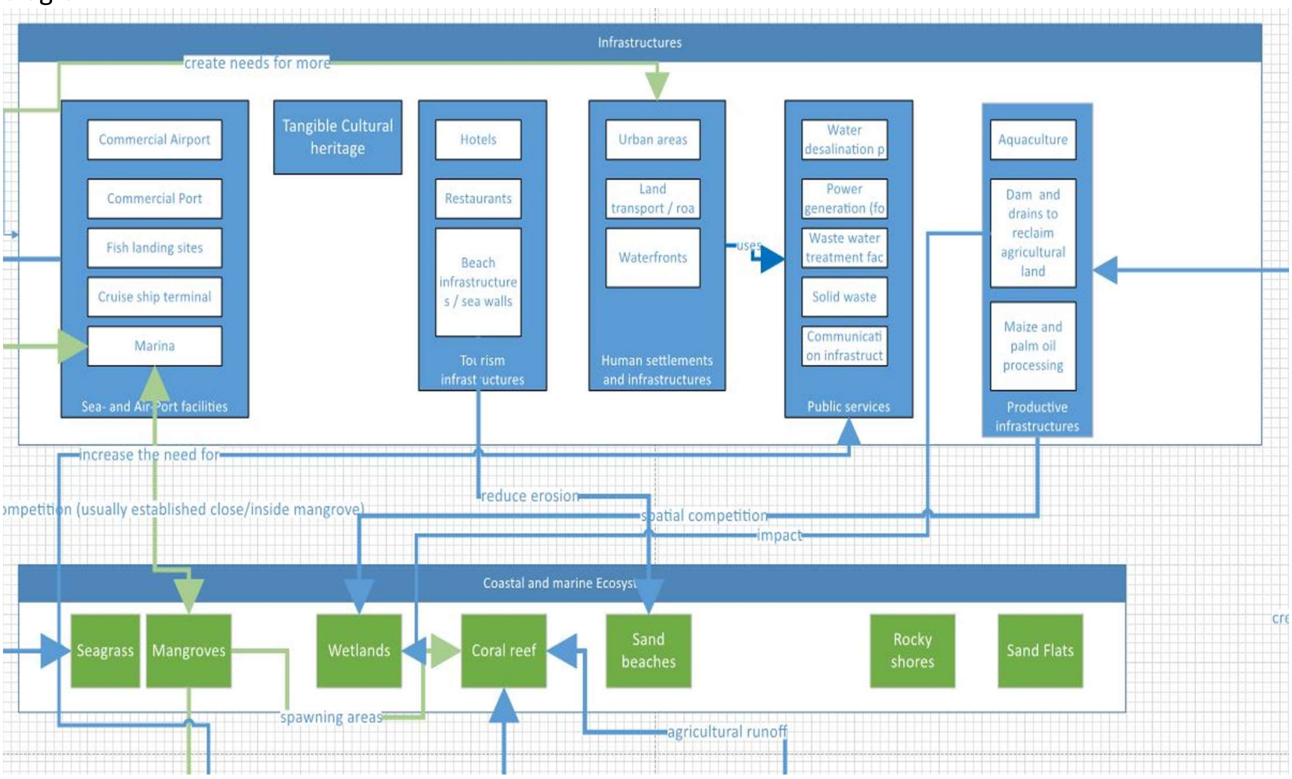

Fig. 3.6 - Example of System boxes-and-arrows System Diagram

At this stage of development, the system-diagram is not providing any additional information other than that already included in the system-matrix. However, this new diagrammatic representation of the same information can help to identify possible inconsistencies and/or incompleteness of the model, either in the definition of components and sub-components (the "structure" of the system being studied) or in their interconnections (the dynamics of the given system, that is the way different components interact).

The EB-ICZM planning team can then work to adjust this basic diagram to solve inconsistencies and remove incompleteness, through a step-by-step iterative process leading to the construction of a strong-structured system diagram modelling the biophysical and human system at the basis of the given EB-ICZM application.

Operational arrangements

The analytical stages of the *Ecosystem Context Analysis* are typically executed in two consecutive workshops involving the entire EB-ICZM planning team defined in Phase 1. This workshops last two or three days depending of the complexity of the given EB-ICZM context, and are executed allowing for a four to six weeks interval between them.

Adapting to the new Covid-19 related situation, the use of remote team-working-channels and webinar tools (Microsoft Teams) will be investigated and tested for the execution of these workshops; to the extent that this may be needed, and that travel may be possible/allowed, remote work may be complemented by in-presence session(s) with limited number of participants.

Phase 3. Development of indexes and indicators for the quantitative assessment of EB-ICZM social, economic and ecological dynamics.

Objective and rationale

The third Phase of the protocol for implementing MED4EBM EB-ICZM applications focuses the development of a set of indexes and indicators for the quantitative assessment of the structural components and dynamics of the EB-ICZM reference systems as they have been defined through the *Ecosystem Context Analysis*. In practical terms, a set of indexes and/or indicators is attached to each of the boxes (structural components) and, if needed, the arrows (dynamics between components) of the System Diagram with the aim of providing a mean for assessing the status and trends of the environmental, social or economic dynamics which the various boxes and arrows represent. For example, the System Diagram component "coral reef habitat" could be characterized though the set of indicators illustrated in Figure 3.7 here below.

Indicator	Information and data	Description
Spatial occurrence	presence of the species for each cell	occurrence of the species per site
Species Richness	number of species per cell investigated	frequency of occurrence on total number of species per cell
Rarity	The rarity of a species is defined by its geographical range measured as the inverse of the number of cells where it was present (1/ni). For a cell r, the rarity index is $$I.R. = \sum_{i=1}^{s} (1/ni) / sr$$ where sr is the number of species found in the cell (or sites)	High value of the index shows high presence of rare species in the site/cell
Vulnerability	For a cell, the vulnerability index $$I.V. = \sum_{i=1}^{s} Vri / sr$$	These categories are previously defined by the IUCN. Degree of vulnerability: 5 = endangered species; 4 = vulnerable and undetermined; 3 = rare; 2 = insufficiently known; 1=non-threatened and introduced species.

Combined biodiversity index	$I.C. = \sum_{i=1}^{s} (1/nri)\ Vr\ i$	Combined index of species richness, rarity, and vulnerability.
Standardized Biodiversity Index	$SBI = \sum_{j=1}^{4} 1/m_j \sum_{i=1}^{jS} (1/n_{ji}) V_{ji},$	m_j refers to the mean combined index of biodiversity of the taxonomic group j across cells (taxa j = mammals, birds, reptiles, amphibians)

Fig. 3.7 - Example of indicators (attached to the "coral reef habitat" ecosystem component)

Outputs

Tangible outputs	Intangible outputs
a) Arrays of indicators attached to each item of the System boxes-and-arrows Diagram.	b) Scientific, technical, administrative and civil-society stakeholders avail a common list of indicators tailor-made to the specificities of the given EBM context.

Methods

Methods and examples for developing effective indexes and indicators to characterize social, economic and environmental dynamics are extensively available in relevant technical and scientific literature and, thus, there is no need for a detailed illustration of such methods in this reference protocol for implementing EB-ICZM applications. Nevertheless, it is worth to recall here some important items to be considered when developing the list of indicators for a given EB-ICZM application.

Indicators are used to describe, inform and evaluate; from an environmental perspective indicators provide an effective tool for:

- the evaluation of an environmental problem;
- the identification of the environmental pressures and threats;
- the monitoring of management decisions and results.

Indicators should be:

- representative;
- measurable;
- efficient;
- easy to understand;
- able to show spatial distribution and time trends of the focused social, economic or environmental dynamic;
- sensitive to changes.

Indicators should also serve to:

- evaluate processes and environmental conditions according to the given objective;
- monitor the efficiency of management actions;
- compare different sites and different situations;
- assess future situations and scenarios.

When describing a given indicator, a minimal set of attributes should be defined as follows:

- the name or label of the indicator;
- the component or dynamics (box or arrow in the System Diagram) of the social, economic and environmental systems involved in the EB-ICZM application to which the indicators is to be

associated;

- a short narrative description, illustrating such issues as the rationale of the indicators, how it should be used, and the unit/method for its evaluation;
- the source of data for its evaluation;
- the recommended frequency for its update.

Operational arrangements

The development of indicators can be either assigned to a team of sector experts/consultants or executed during a dedicated two or three days workshop involving EB-ICZM stakeholders and technical sector experts as well. The second option, however, may be considered more effective as it also help to increase the understanding and ownership of the EB-ICZM process by the local stakeholders.

Adapting to the new Covid-19 related situation, the use of remote team-working-channels and webinar tools (Microsoft Teams) will be investigated and tested for the execution of this workshop; to the extent that this may be needed, and that travel may be possible/allowed, remote work may be complemented by in-presence session(s) with limited number of participants.

Phase 4. Data gathering and construction of tabular and GIS databases.

Objective and rationale

Data are collected from different sources to allow the evaluation of the indexes and indicators defined in Phase 3. These data should be primarily sourced from the databases of the various institutions in charge of the monitoring and/or management of the social, economic and environmental EB-ICZM dynamics associated to the various elements of the system diagram. Useful data can usually be extracted also from technical reports and scientific papers.

The gathered data should then be integrated in two inter-linked tabular and GIS databases, to be designed and implemented according to relevant technical standards. These databases are managed and integrated within the PROGES-ISP_software package to implement the full-fledged EB-ICZM-DSS applications. This EB-ICZM-DSS provides user-friendly and effective tools for the display, synthesis and analysis of time trends and spatial patterns of the indexes and indicators developed in Phase 3, and complete the set of MED4EBM WP3 outputs .

Outputs

Tangible outputs	**Intangible outputs**
a) Tabular and GIS databases to manage the datasets for the above-mentioned indicators. b) EB-ICZM-DSS software application linked to the said databases: 1. real-time analysis of indicators' spatial distribution and time trends (maps, tables, charts); 2. compilation of data-aware advanced reports.	c) Stakeholders: 1. avail a common template for analysing EB-ICZM social, economic and ecological dynamics; 2. through the EB-ICZM-DSS software, can quickly browse and easily analyses the extensive datasets involved in EB-ICZM applications. 3. through the EB-ICZM-DSS software, can collectively draft simple but comprehensive reporting material on the EB-ICZM planning process.

Methods

Better that at the direct acquisition of the needed datasets, data collection activity should be targeted at establishing data sharing protocols between the various organizations which hold the said datasets and the institution responsible for the implementation of the EB-ICZM. This is mainly because EB-ICZM applications involve a wide array of thematic sectors and require large datasets. It is thus better to rely on the different institutions which have the institutional mandate to generate a given dataset rather than centralizing the data generation process. This approach also facilitates the regular updating of the various datasets. The data collected are integrated in the two inter-linked tabular and GIS relational-databases of the EB-ICZM-DSS applications.

Operational arrangements

The organization and implementation of data collection campaigns is evidently dependent on both the actual data needs as well as on the local institutional framework. Specific forms will be prepared to guide the personnel involved in the data collection activities, as well as to keep track of the progress.

Phase 5. *System Cause-Effect-Analysis*: assessment of ecological risks and socio-economic stresses and identification of management interventions.

Objective and rationale

The *System Cause-Effect Analysis* is aimed to identify in a systematic manner all possible significant cause-effect relationships between the different components of the EB-ICZM system, as captured in the boxes-and-arrows system diagrams resulting from Phase 2. These cause-effect relationships are quantitatively assessed through the indexes and indicators developed in Phase and associated with the different items of the system boxes-and-arrows diagram.

Outputs

Tangible outputs	**Intangible outputs**
Quantitative integrated assessment of: a) the conservation status of the biotic and abiotic components of the natural ecosystem (e.g. favourable/unfavourable); b) the use of ecosystem services (e.g. untapped-potential/ sustainable use/overexploitation); c) livelihood levels (e.g. adequate/inadequate; increasing/decreasing). d) An integrated set of EB-ICZM measures directly derived from (and targeted) to the relevant components of the ecological and human system (or interaction between them). e) A structured indicator framework to monitor the EB-ICM performance.	f) Stakeholders develop and avail a shared understanding of ecological risks and socio-economic stress.

Methods

The *System Cause-Effect Analysis* is a straight forward procedure aimed at defining an integrated set of management measures coherent with the ecosystem based management principles. It is based on the same conceptual approach and builds upon the outcomes of the *Ecosystem Context Analysis* executed in the previous Phase 3. It is a very simple process that systemically analyses all the elements of the boxes-and-arrows system diagram developed through the *Ecosystem Context Analysis* of Phase 2 by means of the indexes and indicators defined in Phases 3 and evaluated with the data collected in Phase 4.

The process for executing the *System Cause-Effect Analysis* is illustrated in Fig 3.8; it considers systematically pairs of components of the said diagram to: i) assess the conservation and/or development status of the pair's components and their interaction; ii) estimate the current level of use, of overexploitation, or of untapped-potential of the relevant ecosystem services; iii) use these assessments and estimates to identify management measures targeted to the sustainable use of the ecosystem services.

N.	Component		Direct Interaction with other components		Management options
	Name	Quantitative analysis	Related Component	Description of the interaction between components	
9	Forests	Three main types of forests have been identified in the Park, as described in rows 12 to 14.	Timber forest products	According to local knowledge, timber and firewood harvesting are currently localised in 7 villages of the Rrajce communes (deciduous mesophilous forests) and in parts of the sub-montane belt (deciduous termophilous forest). As seen in row 2, past fires, timber extraction and fodder harvesting have contributed to widespread deforestation in the sub-montane belt (deciduous termophilous forest).	Provide economically and environmentally sustainable alternatives heating and cooking energy sources to rural communities (focusing on Rrajce commune).

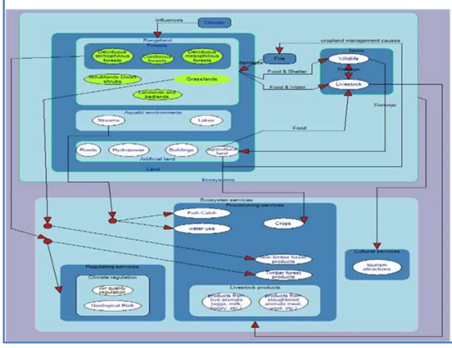

Figure 3.8 - System Cause-Effect Analysis

Following this procedure, each of the identified management measure responds to the conservation and/or sustainable development needs pertaining to the components' pair to which it is associated; this is because these needs are identified as those ensuring the sustainability to the socio-ecological interaction between the very pair of components. When moving to the following step of the analysis, i.e. to that of other pairs of components to identify a new management measure, possible side-effects of the previous measure are inevitably considered when the analyzed pair includes one of the two components of the previous pair. The systematic execution of the above analyses throughout all the elements of the boxes-and-arrows system diagram (which represents stakeholders' common understanding and management view of how environmental, social and economic considerations fit together in EB-ICZM applications) ensures that the resulting set of management measures is coherent with the changes in management practices which characterize ecosystem based management: (1) each human activity is managed in the context of ALL the

ways it interacts with ecosystems, and (2) multiple activities are being managed for a common outcome. Baseline and target for assessing the performances in the implementation of these management measures can be defined using the same set of indicators worked out in Phase 3.

Operational arrangements

The *System Cause-Effect Analysis* is typically executed in one workshop involving the entire EBM planning team defined in Phase 1. This workshop lasts two or three days depending of the complexity of the given EBM context. Analyses executed during the workshop are supported by using the EB-ICZM-DSSs established in Phase 4, thus making the *System Cause-Effect Analysis* much easier and faster de facto allowing for its execution in a single workshop involving all EB-ICZM stakeholders rather than through longer and less effective process. The EB-ICZM-DSS software allows the easy and effective retrieval of all the data integrated in the two inter-linked databases resulting from Phase 4. Effective analyses of spatial distribution and time trends of the indicators defined through Phase 3 can be easily executed via a multi-windows user friendly interface; the software also allows the compilation of data-aware advanced reports. The main window of the software shows maps, tables or charts, system diagrams, and a space for notes, comments or a report draft. It gives the opportunity to visualize different kind of data and information with the view to compare the various system components targeted by a possible management action. The software also includes a tool (hyperlink) that automatically links the name of the components in a report to the components shown in the EB-ICZM-DSS, as well as their related maps, tables or charts, in order to support the decision-making process.

Adapting to the new Covid-19 related situation, the use of remote team-working-channels and webinar tools (Microsoft Teams) will be investigated and tested for the execution of this workshop; to the extent that this may be needed, and that travel may be possible/allowed, remote work may be complemented by in-presence session(s) with limited number of participants.

Phase 6. Mainstreaming EB-ICZM measures into local development plans.

Objective and rationale

Mainstreaming the EB-ICZM management measures into existing plans of relevant sector institutions and management authorities.

Outputs

An effective multi-level ICZM governance protocol (EB-ICZM-GP) in the four areas targeted by MED4EBM.

Methods and Operational arrangements

MED4EBM Partners will liaise and support relevant local institutions and actors in designing and implementing initiatives aimed at implementing the developed EB-ICZM measures. How to plan and implement this liaison strongly depends on the political, institutional and management setup of the various MED4EBM target areas, as well as on the actual management measures that will be developed throughout the execution of Phases 1 to 5. Specific methods and operational arrangement for executing Phase 6 will therefore be defined at a later stage of MED4EBM deployment.

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