Proposals for the Integrated Ecosystem Management of the Gulf of Corigliano

MED4EBM Project: Analysis and Prospects for the Italian Project Area

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Abstract

This document aims to identify a potential integrated coastal zone management plan of the the "Gulf of Corigliano". In this area, the Ecosystem-Based Management (EBM) methodology will be applied. To do so, two key socioeconomic sectors, agriculture and tourism, have been identified as main driving forces exerting various pressures and impacts on the environment of the target area. The final goal of the document is to define several possible management measures that would help reducing these specific impacts. By doing so, it will be possible to obtain enhanced socioeconomic and environmental advantages for the communities engaged in the project area in a more efficient and effective manner.

This document is the result of the activities carried out from 2020 to 2023 as part of the project MED4EBM, which is described more in detail in Chapter 1. The activities undertaken over these three years can be summarized as follows:

- Participatory analysis of the project area. Stakeholder engagement played a crucial role in order to establish a shared knowledge base of the area, including a detailed analysis of its social, economic, and environmental aspects.
- Systematization of the available knowledge into a Decision Support System (DSS). Such system encompasses quantitative and qualitative data. It can contribute to identifying socio-economic and environmental dynamics in an organized manner and with the ability to track their temporal evolution. This work was essential in revealing data gaps that may inspire future investigations and monitoring.
- Creation of the "Mediterranean Forum For Applied Ecosystem-Based Management". This platform is based on the project partnership network, and it is a space where best practices, techniques, methodologies, and case studies for ecosystem-based management of coastal areas throughout the Mediterranean are shared.

This activity framework was applied in all the partner study areas of the project (Jordan, Italy, Lebanon, and Tunisia). In each of these areas, the results of the work have contributed to identifying potential a set of management measures shared with the local communities. These measures represent the practical application of the principles of Integrated Coastal Zone Management (ICZM) for the four project areas.

MED4EBM Project

MED4EBM (Mediterranean Forum for Applied Ecosystem-Based Management) is a partnership project funded by the ENI CBC MED 2014-2020 program. The project aims to promote integrated Ecosystem-Based Management (EBM) of coastal and marine areas (ICZM) in designated regions of four Mediterranean countries: Italy, Tunisia, Jordan, and Lebanon. Amici della Terra is participating in the MED4EBM project as the managing authority for the Natural Reserves of lake Tarsia and the mouth of Crati river, located in the Gulf of Corigliano, in the Calabria region (**Annex 1**).

EBM is an environmental management approach that aims to contribute to the conservation and sustainable development of ecosystems and habitats. To do so, it harmonizes economic and social interests with the preservation and enhancement of the natural environment. Coastal areas, due to their high environmental fragility and ecological diversity, along with a high level of human pressure, require integrated spatial development strategies capable of balancing active protection and territorial enhancement, involving local communities. EBM strategies recognize ecological systems as a rich set of interconnected elements. Implementing effective ecosystem-based management requires an interdisciplinary approach that balances ecological, social, and governance principles, incorporating the analysis of data on various interactions over appropriate temporal and spatial scales. EBM strategies recognize ecological systems as a complex web of interconnected elements. To effectively implement ecosystem-based management, it's essential to adopt an interdisciplinary approach that considers ecological, social, and governance principles. This approach involves analysing data related to various interactions over appropriate temporal and spatial scales.

The MED4EBM project provides innovative methods and tools that facilitate territorial planning in all its aspects. They make integrated ecosystem management accessible to policymakers, stakeholders, and all institutional actors. This approach aims to enhance the intervention capabilities of local institutions, helping them make informed decisions regarding the management of coastal resources.

The main expected outcomes of the project involve the implementation of a Decision Support System (DSS). It will assist in formulating management proposals in agreement with all stakeholders and local institutions, contributing to more efficient ecosystem-based management. Secondly, the project aims to establish a permanent Forum, a cooperation and coordination platform where Mediterranean countries can exchange experiences and best practices in integrated coastal zone management.

Ecosystem Context Analysis

In the first phase of the project a multidisciplinary group of stakeholders was engaged in a series of workshops aimed at conducting an Ecosystem Context Analysis. This analysis focused on the project area, the Gulf of Corigliano, which also includes the protected areas managed by Amici della Terra (**Annex 1**).

The decision to perform the ecosystem context analysis not only within the Natural Reserves boundaries, but to extend it to all the municipalities bordering the Gulf of Corigliano, is driven by two main reasons. The first reason is that in order to apply the EBM approach and understand all the pressures on the Natural Reserves, it is essential to study what exists also outside of them. This is especially true in the defined project area, where tourism and agriculture, the two most important human activities, significantly affect the state of the Natural Reserves. The second reason is that the authorities and the stakeholders involved in the project, rather than operating solely within the Natural Reserves (where the competent authority is Amici della Terra itself), are located outside of them. (aggiunto alle versione in Italiano)

The analysis of the project area, the Gulf of Corigliano, was carried out through a participatory process coordinated by EBM experts. Representatives from civil society, technical and scientific organizations, and relevant administrative institutions came together to achieve a common understanding of the territorial context. Active participation of stakeholders in the workshops served to develop a manageable and comprehensible structural model of ecosystem components and services, associated human activities, and relevant ecological interactions. All identified biotic, abiotic, and economic components, as well as key connections between them, were then spatially organized using containers and arrows to create a system diagram.

The initial version of the diagram was subsequently reviewed by Amici della Terra experts, still retaining the complexity of information shared by the stakeholders. The names of the components were aligned with the official designations provided by the entities responsible for data production and dissemination in Italy. Some components that were only briefly mentioned during the workshops, but considered central to ecosystem management in the project area, were added to the diagram. Finally, the visual appearance of the diagram and the spatial organization of containers and arrows were modified. The final result is a diagram with improved visibility and clarity, where ecosystem components are divided into two interconnected main matrices: the environmental matrix and the socio-economic matrix (**Annex 2**).

The collaborative work conducted during the Ecosystem Context Analysis phase led to a purely qualitative description of each component and to an initial step towards their quantitative characterization. At this stage of the work, experts identified, for each component in the diagram, a set of data and indicators necessary for the analytical assessment of ecosystem functions, services, and associated human activities. This guided the data collection, standardization, and presentation efforts.

System Cause-Effect Analysis of Ecosystem Components

The subsequent phase of MED4EBM was characterized by the System Cause-Effect Analysis It was carried out through a series of workshops involving both Amici della Terra working group and EBM experts. This phase was a key step in the application of integrated ecosystem management strategies and had a dual objective. From the one hand, the current and potential levels of ecosystem service utilization were identified. Moreover, ecological risks and socio-economic stresses in the project area were identified. The system cause-effect analysis conducted during the workshop cycle led to the identification of two main driving forces, tourism and agriculture, and the quantification of the ecosystem dynamics associated with them. They have to be understood as factors of human presence and activity that significantly influence the characteristics of environmental systems in the project area and so in the Natural Reserves.

The outcome of the meetings was a document divided into three sections that systematically addressed each of the environmental dynamics related to tourism and agriculture. The first two sections of the document structure, which was designed specifically for the system cause-effect analysis, were used for studying and quantifying cause-effect relationships between pairs of components in the system diagram. In this phase, the nature of the relationship was described, and the related regulatory framework was reported. Quantitative analysis was conducted by detailing the available data and their associated issues related to data collection and standardization procedures. Additionally, a set of indicators was prepared to effectively address the need for environmental information in line with European and international objectives and targets. This ensured the indicators to be continuously updated as required for ongoing monitoring of the considered relationships within the system cause-effect analysis document.

Throughout this process, the Decision Support System (DSS) allowed for the retrieval of information on the spatial distribution and temporal trends of indicators with ease. With this tool, experts could systematically identify and quantify all possible significant cause-effect relationships between different components in the system diagram. Finally, in support of the analysis, graphical attachments in the form of maps and tables exported from ISP software were added to the document. The work performed enabled the compilation of the third section of the document, aimed at identifying ecosystem management measures in response to the issues revealed during the cause-effect analysis.

Implementation of ISP DSS Software

The application of EBM strategies requires in-depth knowledge of the studied territory and its ecosystem dynamics. To cover the wide range of thematic areas identified during the Ecosystem Context Analysis and incorporated into the system diagram, large datasets are required to assess the indices and indicators defined by stakeholders in the project's initial phase. Data collection activities were carried out with a priority for a participatory approach, favouring data-sharing protocols established with the institutions that participated in the workshops. The choice of relying on stakeholders, rather than centralizing the research process, facilitated the regular, progressive updating of various datasets and the organization of data collection campaigns. Relevant dataset important for the description of ecosystem in the Gulf of Corigliano came from, among others, ARSAC, the University of Calabria, and ARPACAL. In the absence of data useful for describing the components of the diagram, Amici della Terra's team of experts obtained data from online data banks of major national and international organizations and entities (including ISTAT, ISPRA, the European Environment Agency).

The raw data collected, after being formatted and uploaded into a database, were integrated into a Decision Support System (DSS) developed by PROGES, the technical and methodological partner of MED4EBM. This type of tool is designed to automatically process large amounts of data and can integrate tabular and geographic information, improving decision-making processes that are not entirely structured. The software used in MED4EBM is called ISP (Integrated Spatial Planning) and features an interface divided into four main panels: the system diagram, where data or documents can be "attached" to each component (box) or connection (arrow). The indicator panel, where specific indicators can be created for each of the system diagram’s items. The system then processes the uploaded data and returns it in the other two panels of the interface in the form of charts and maps. Through ISP, experts from various sectors can access detailed information on the components of the diagram of their interest. They can perform diachronic or synchronic analyses based on their needs, while also maintaining an overview of other territorial issues. The user-friendly interface of the software allows its use also to less experienced users, making it extremely useful for all stakeholders involved in decision-making processes who need to quickly recognize the existing dynamics in the territory.

The management of ISP by the team of experts of Amici della Terra, during the data upload and indicator setting phases, had two primary objectives. The first goal was to make the software usage simple and flexible, avoiding overloading the system with excessive and non-useful information. The hierarchical structure of the diagram played an important role in this regard, as it was designed to facilitate data consultation with varying levels of detail. Secondly, with the aim of updating the datasets in the future, particular attention was given to creating and maintaining a metadata repository that is incorporated into ISP in a tool called Data Management Toolbox. This tool is particularly useful because it helps track the metadata, including the characteristics of all datasets, regardless of their origin or format, allowing any operator to update the data.

At the end of the data upload phase, the main components of the system diagram were adequately populated and represented. Before proceeding to the next phase of the project, the team of experts at Amici della Terra considered it necessary to conduct a gap analysis. This step was essential for identifying data gaps that were essential to complete the knowledge framework of the study area and its environmental and socio-economic components. Where possible, knowledge gaps were filled by exploring new data sources and intensifying relationships and information exchange with local institutional actors.

Ecosystem Management Measures in the Gulf of Corigliano

The work carried out during the System Cause-Effect Analysis has allowed the team of Amici della Terra to highlight the externalities resulting from the two main driving forces that exert the greatest pressure on the environment in the Gulf of Corigliano area: tourism and agriculture. These two major themes and the relationships they have with other components of the system diagram were studied in-depth in the first two sections of the project document through the identification, analysis, and assessment of environmental risks. Once the phase was concluded, a program of specific environmental improvements was established.

For this purpose, the team of EBM experts, in coordination with stakeholders, defined a coherent and integrated set of management measures, with the support and use of the ISP software, the system diagram, and the indications resulting from the system cause-effect analysis. The work was carried out by compiling the third section of the project document. Here, integrated management measures were formulated and detailed, taking into consideration all the ecosystem elements in the project area, and addressing the needs for environmental conservation and sustainable socioeconomic development of the coastal zone.

Firstly, the hypotheses suggest actions for mitigating the effects of excessive anthropogenic pressure on the coastal zone, where the current ecological carrying capacity is at risk of being exceeded. Secondly, the proposed measures aim to enhance the complex environmental and structural resources of the project area while preserving the landscape and coastal values.

The analysis of the identified management measures, with specific details regarding the dynamics related to tourism and agriculture, are addressed in the subsequent chapters. The choice of this document organization better serves the need to disseminate knowledge of ecosystem management among interested parties and institutions seeking to improve their skills and performance in the environmental field.

Tourism

During the first phase of the Ecosystem Context Analysis, tourism was identified as one of the factors that can lead to critical environmental conditions and stress, especially for more fragile and sensitive areas such as natural and coastal areas. While tourism undoubtedly generates wealth, the balance of tourism outputs can be negative when the ecological carrying capacity of an area is exceeded. This situation occurs when anthropogenic pressure degrades the available natural resources and prevents their regeneration. Outputs of tourism that contribute to significant degradation include water resource consumption, poorer quality of coastal waters and air, increased waste production, land consumption due to excessive infrastructure and urbanization. All of these elements can fragment habitats and compromise biodiversity of natural environments. In contexts with such tension between anthropogenic activities and the need for conservation, planning strategies are required, on the one hand, to protect environmental resources. On the other hand, they have to simultaneously avoid the loss of economic and social benefits derived from the tourism exploitation of those resources.

The project area under consideration, largely coinciding with the plain of Sibari in front of the Gulf of Corigliano, has historically been oriented towards the sea. In the past, it was at the centre of trade with civilizations from the eastern Mediterranean. Today, it is characterized as a strongly tourist and beach-oriented area. Along the approximately 68 km of coastline, there are six municipalities facing the sea: Amendolara, Albidona, Trebisacce, Villapiana, Cassano all'Ionio, Corigliano-Rossano. In recent decades, the area's pronounced tourist oriented character has led to a transformation of the entire coastal landscape, with significantly increased built-up areas. Tourist villages, resorts, and coastal settlements, mainly characterized by the phenomenon of second houses, have been added to the historical residential centers located far away from the coast. Often, these are new agglomerations built in a context of unauthorized construction, generating an urban fabric without centrality and lacking integration with the rest of the settlement context. Notable examples include Marina di Amendolara, Villapiana Scalo, Villapiana Lido, Marina di Sibari, Laghi di Sibari, Il Salice, Marina di Schiavonea, Lido Sant'Angelo, and La Zolfara.

EBM specialists and Amici della Terra technicians defined an initial set of indicators to directly or indirectly measure tourist presence in the area and its impact on environmental resources. The indicators, selected from the database of environmental indicators by ISPRA, are within the national and European DPSIR framework (Driving forces, Pressure, State, Impact, and Response). However, it's important to note that the choice and number of indicators proposed were influenced by the availability and completeness of data, which was often insufficient. The identified indicators are summarized as follows:

1) Hotel and non-hotel accommodation facilities
2) Tourism intensity
3) Average length of stay
4) Number of agritourism

5) Incidence of tourism on waste
6) Incidence of tourism on drinking water consumption

A. Indicators for Tourism

1) Hotel and non-hotel accommodation facilities. In the project area, as of 2021, there are 188 accommodation facilities with 27,000 beds, averaging 146 beds per facility. One-third of these facilities fall into the "hotel accommodations" category, which includes hotels, fewer in number but larger in size. The remaining two-thirds of the facilities are extra-hotel accommodations, primarily consisting of campgrounds and tourist villages, providing 16,000 beds, which is more than half of the entire area's capacity. Geographically, the tourism offer is concentrated mainly in the municipalities of Corigliano-Rossano and Cassano all'Ionio, which host 70% of the area's accommodation facilities and 90% of the total bed capacity. Moreover, roughly half of the total bed capacity is located in the numerous campgrounds and tourist villages along the coastal strip. The spatial distribution of the accommodation facilities, categorized by type and the number of bed spaces, can be observed in **Annex 3** and **Annex 4**. However, this analysis does not include second houses, which are a very common form of lodging but for which relevant data is not available.

2) Tourism intensity (Annex 5). The indicator represents the ratio between tourist stays and the resident population, and it reflects the tourist pressure on a specific area. This pressure is higher in the municipalities of Cassano all'Ionio and Villapiana, with values in terms of stays per resident population of 21 and 18, respectively. This is in contrast to the national average of 7, a regional average of 5, and a provincial average slightly above 3. It's a different situation in Corigliano-Rossano, the most populous and extensive municipality in the area, which appears to be capable of absorbing the massive tourism pressure. However, it's important to note that tourist flows are concentrated temporally, during the summer months, and geographically, along the coast, which represents only a small part of the vast municipal territory and receives the greatest anthropic pressure.

3) Average length of stay (Annex 6). The indicator shows the ratio between the number of nights spent at the accommodation facility and the number of arrivals. The average length of stay in the municipalities of Corigliano-Rossano, Cassano all'Ionio, and Villapiana is approximately 7 nights. This value, more than double the national average, reflects the area's tourist vocation as a holiday destination during the beach season. The relatively undiversified tourism offer, the infrastructure, and the area's characteristics are not suitable for the "short-break" tourism type.

4) Number of agritourism (Annex 7). This is an indicator of the quality of the tourist offer, considering agritourism as a form of activity integrated into the territory and respectful of biodiversity and the landscape. It is an indicator that takes into account agritourism that offer not only accommodation services but also may include catering, food and wine tastings, and other activities such as hiking and educational farms. As of 2019, the most recent year for which this type of information is available, there were a total of 60 agritourism in the project area. The most represented municipality is Corigliano-Rossano, with 29 agritourism businesses, followed by Amendolara (9) and Tarsia (7).

5) Incidence of tourism on waste (Annex 8). The increase in waste production is one of the most significant impacts that tourism has on an area. The indicator is obtained by calculating the difference between per capita production of urban waste, calculated using the resident population, and per capita production of urban waste calculated using the equivalent population, which is the sum of the resident population and the tourist arrivals distributed over 365 days. From the analysis of the data, the highest value is recorded in the Municipality of Villapiana with 35 kg of waste, followed by Corigliano-Rossano Municipality with 8,4 kg. These values are higher than the national average of 9 kg, the regional average of 5 kg, and the provincial average of 3,6 kg.

6) Incidence of tourism on drinking water consumption (Annex 9). This indicator helps quantify the water footprint of tourism, which is the additional demand for water resources resulting from the increased demographic pressure on the territory due to the presence of tourists. The water withdrawal for drinking water, in addition to the irrigation volumes used in agricultural activities, occurs mainly during the summer season when tourist pressure is higher. The indicator was calculated for the year 2015, the last year for which data on drinking water supply are available at the municipal level, using the same methodology proposed to quantify the impact of tourism on waste production. In this case, tourist flows have a more significant impact in the municipalities of Villapiana, with consumption attributable to each tourist of 11,6 liters. Then there is Cassano all'Ionio, with a consumption of 6,5 liters. Both values exceed the national average, which in 2015 was 3,7 liters, as well as the regional (3,3 liters) and provincial averages (0,13 liters).

B. Focus on the Quality of Bathing Waters

Given the specific characteristics of the area and the project goals of coastal ecosystem management, an important step in the cause-effect analysis was to characterize and quantify the externalities resulting from tourism. Hence, during the System Cause-Effect Analysis, it was necessary to examine the negative interferences on the areas with a higher degree of naturalness, particularly those located near the coast in the project area. Among them there are areas such as the Natural Reserves of the mouth of the Crati River, the Casoni di Sibari, the Saraceno and Avena rivers. A comprehensive understanding of the situation was a prerequisite for implementing actions to reduce the impact of human presence, especially tourism. Indeed, it exerts significant pressure along the coastal strip. This understanding is crucial for formulating shared measures aimed at preserving and enhancing environmental resources.

Among the externalities related to such temporally and spatially concentrated tourist activity, there is pollution of the marine-coastal waters. Therefore, the focus has been on the state of health of the sea. This is an important theme not only for the health of the residents and tourists, but because it represents a prerequisite for the sustainable management of the coastal area. Initially, the working group decided to limit the scope of research to only microbiological pollution. In this specific context, the relevant EU legislation is Directive 2006/7/EC, which identifies Escherichia coli and Enterococcus as the two microbiological parameters that regional ARPA agencies must monitor to assess the quality of bathing waters. This directive also specifies the sampling frequency during the summer season and the maximum concentration limits for a coastal area to be considered suitable for swimming. The classification of multiple official monitoring points, 64 of which are located along the coast in the project area, depends on the concentration levels of these two parameters.

For individual samples, the maximum acceptable value for Enterococcus is 200 CFU/100 ml, and for Escherichia coli, it is 500 CFU/100 ml. Exceeding either of these limits requires the prompt implementation of management measures, including the prohibition of swimming near the sampling point. These data were obtained from the Italian Ministry of Health's Water Portal, which provides them for each monitoring point in the project area. However, it is worth noting that updating the data and applying environmental indicators in this context is challenging. The values of these two parameters are available for the most recent bathing season and must be manually transcribed for all 64 relevant sampling stations. Due to these challenges, data for the years 2019 and 2020 have been recovered manually. Additionally, efforts have been made to establish contact with ARPACAL, the regional agency in charge of the collection of these data, to complete the dataset and facilitate future updates.

Furthermore, based on the results of long-term analyses (typically over a four-year period), the sampling points are classified as excellent, good, sufficient, or poor. Being classified in the last of these classes results in a permanent bathing ban for hygiene and health reasons until remediation is achieved. Data regarding the sampling points evaluated according to the four different quality classes have been obtained from the European Environment Agency (EEA), which provides a historical series of data from 1990. The data were then linked to the related component in the system diagram. Afterwards, from the data analysis performed in

the ISP, the overall water quality for bathing results currently good along the entire coastal strip of the project area (**Annex 10**).

This result also reflects a general improvement noted in 2021. Just a decade earlier, out of the 64 sampling points, 42 were excellent and 22 only sufficient. In contrast, the comparison with the 2015-2016 period shows a decline: at that time, all 64 profiles had excellent bathing water quality. In 2021, there are 42 points with excellent quality, 18 with good quality, 2 with sufficient quality, and only one point with poor quality (IT018078044007, 100 MT DX TORRENTE CORIGLIANETO). The last three points fall within the municipality of Corigliano-Rossano, specifically in the coastal area in front of Marina di Schiavonea, where just four years earlier, all sampling points were considered excellent (**Annex 11**).

To continue with the analysis, the bathing water quality was initially related to the spatial distribution of accommodation facilities, classified according to a colour gradient (**Annex 12**) or size (**Annex 13**) based on the number of beds. This analysis, facilitated by geocoding the regional database of accommodation facilities, provides an initial evaluation of the impact of tourist activity on the coastal-marine region, with a specific focus on the quality of bathing waters. This is particularly relevant as a considerable portion of accommodation facilities is concentrated in close proximity to these coastal areas.

In the subsequent phase of the system cause-and-effect analysis, the team studied how the determinants exert pressure in terms of pollution, whether it's point source pollution or diffuse pollution, on bathing waters. Tourist activities result in a significant additional load on the urban wastewater treatment process, which is one of the major sources of microbiological contamination of waters. This contamination is also influenced by factors related to the population and agriculture. In the case of tourism, the pressure manifests as point source pollution mainly at urban outfalls, which can lead to direct impact when discharges occur within bathing waters or indirect impact when discharges occur in water bodies that later flow into bathing areas.

Therefore, the goal of Amici della Terra expert team was to establish a relationship between any overloaded treatment plants, the hydrographic network, and the location of sampling points along the coast with negative assessments in terms of bathing water quality. Data collection procedures on wastewater are regulated by the Urban Waste Water Treatment Directive (UWWTD) 91/271/EEC of May 21, 1991. The most relevant available information pertains to the treated load and the capacity expressed in Population Equivalent (P.E.), both of municipalities and individual treatment plants. The P.E. value represents the combined load of the population, enterprises, and tourists, and therefore is higher in areas with larger urban populations.

As shown in **Annex 14**, the treatment plants experiencing higher anthropogenic pressure, that is where the percentage of inflow load compared to their capacity is higher, are located near the cities of Marina di Schiavonea, Corigliano Scalo, Rossano Stazione, and further north, Marina di Sibari. This is the southern part of the coastal strip in the project area, where the monitoring points are also less favourably evaluated for the classification of bathing water quality. However, it was not possible to perform a more detailed analysis due to two critical

issues. The first concerns the incomplete data, especially those related to the microbiological parameters of wastewater discharged at the discharge points. Additionally, for a comprehensive view of the real impact of the wastewater system on bathing water quality, the presence of numerous water bodies subject to illegal discharges should be considered. This phenomenon is well known especially in the municipality of Corigliano-Rossano, but it is excluded from ordinary monitoring activities and therefore absent from official data.

C. EBM Measures for Tourism

Despite the numerous opportunities offered by the territory in terms of environmental and scenic resources, tourism has experienced a monothematic development in the project area. Indeed, it is primarily linked to the seasonal beach tourism during the summer season. The resulting pressures on the coastal strip, where accommodation facilities and tourist flows are concentrated, therefore require integrated mitigation and adaptation strategies that create conditions for diversifying tourism offerings in the area. In this way, tourism could become more flexible and competitive.

The work carried out during the System Cause-Effect Analysis brought to the identification of management measures with a dual purpose. On the one hand, these measures aim at developing and promoting sustainable tourism, which should be capable of rebalancing the pressures related to tourist flows, redistributing them among the numerous historical, cultural, natural, and landscape attractions in the project area. On the other hand, it was considered necessary to enhance the standards of tourism offerings, products, and related services by proposing alternative models of reception with an eco-sustainable footprint.

In this scenario, it is important to restore the sea-mountain connectivity by increasing the attractiveness of the natural and cultural heritage, offering an alternative to purely beach tourism. The process of depopulation that the hinterland has undergone in recent decades has generated economic and social decline, relegating the specificities of the territory to a marginal role, far from tourist flows. This process has been fuelled by inadequate infrastructure in the more remote areas and the lack of strategic planning by competent authorities. On one hand, this situation has kept the historical, natural, archaeological, and cultural specificities outside of specialized tourist circuits. On the other hand, it has allowed the pursuit of the unsustainable model of land consumption for coastal resource exploitation. Smaller towns and the rural landscape, which are custodians of valuable historical and cultural heritage, traditions, and local identities, become now the focus of a process of recovery and enhancement from a tourism perspective.

Criticality: Low quality of the accommodation offer, with a prevalence of non-hotel structures (camping and tourist villages) and second houses.

Objectives: Qualification and diversification of the accommodation offer with expected outcomes:

- Improvement of quality standards for existing structures and complementary services.
- Creation of alternative and widespread forms of hospitality.
- Recovery, efficiency, and enhancement of existing building heritage.

Tools:

- Encourage the recovery and reuse of historical building heritage, favouring sustainable networks such as the "scattered hotel". This aims to enhance small inland towns and villages that in the project area are usually rich in history and traditions.
- Promote the creation of agritourism activities run by local agricultural enterprises. They should serve as outposts and indicators of sustainable tourism. These structures are intended for preserving local identity while promoting agricultural products of excellence. This can be achieved through the recovery and enhancement of historical rural properties, such as farmsteads (masserie).
- Increase and diversify the offer of complementary services provided by accommodation facilities, integrating them with the environmental and cultural resources of the territory (hiking, trekking, birdwatching, tasting of food products).
- Develop and consolidate the digitalization of services in tourism businesses (computerization of accommodation services, starting from room reservations).

Criticality: Undiversified tourist offer which is mainly based on seaside tourism.

Connected issues:

- Poor enhancement and underutilization of existing archaeological, cultural, architectural, artistic, and environmental resources.
- Limited functional integration between the coast and inland areas, which have inadequate infrastructure and few economic and social opportunities.

Objectives:

Diversify the tourist offer by promoting the enhancement and competitive repositioning of other tourist destinations. Expected results:

- Decongestion of areas with high tourist/settlement density, alleviating the coastal area from excessive anthropic pressure.
- Increase of quality tourism in terms of arrivals and stays, involving the local specificities of the inland areas in this process.
- Reduction of extreme seasonality in tourism and extension of the opening of accommodation facilities throughout the year as a result of more stable and diversified tourist circuits.

Tools:

- Strengthen, qualify, and promote thermal baths and related complementary services to capture demand for therapeutic and aesthetic purposes.
- Promote and enhance the archaeological heritage, especially the Archaeological Park of Sibari, the Archaeological Museum of Sibaritide, and the National Archaeological Museum of Amendolara.
- Restore the functionalities of the historic centers of Sibaritide, which was subject to depopulation and abandonment in favour of better-served coastal locations with greater social and economic prospects. Urban redevelopment, public green spaces, and urban furnishings, enhancement of services for citizens and tourists (sports facilities, municipal transport networks, etc.).
- Improve the accessibility and sustainable usability of main tourist destinations and cultural and natural attractions by creating suitable services that favour sustainable modes of connection (bike paths, sustainable routes, hiking trails).
- Digitize the tourist offer through information systems that promote greater knowledge and awareness of historically and environmentally underutilized specificities.
- Implementation of informative and promotional products and services and the creation of thematic itineraries.
- Creation of a tourism roundtable to encourage interaction between public and private stakeholders and to share policies for the promotion and governance of tourist destinations.

Criticality: Excessive water consumption and waste production in the tourism sector.

Connected issues:

- Widespread losses in the drinking water distribution system due to the difference seen between the water introduced into the network and the water actually supplied.
- Discontinuity in the supply of drinking water linked to the summer increase in demand, especially in tourist areas.
- Dispersion of waste in the marine-coastal area and compromise of more natural environments (beaches, sea, pine woods).

Objectives: Rebalance the tourist impact on water consumption and waste production:

- Reduce the irresponsible use of local natural resources in the local accommodation system and related activities (restaurants, bathing establishments, etc.).
- Increase tourists' awareness of the risks associated with pollution and overexploitation of environmental resources.

Tools:

- Use of ecological certification systems with strict evaluation and classification criteria that guarantee the ethical and environmental quality of the accommodation facility or tourist activity.
- Incentivize the reuse of less precious water, such as treated wastewater or rainwater, for irrigation purposes (green areas, fountains, recreational and sports activities) and for all water needs in the tourism sector (pools and toilets in hotels).
- Promote sustainable use of coastlines with plastic-free campaigns and awareness-raising about separate waste collection. The awareness process can take place through the installation of informative signs, radio campaigns, or in schools.

Criticality: Excessive pressure on protected areas and natural areas along the coastal strip (pine forests, dune systems).

Objectives: Enhance the structural role of environmental connectivity of the river network.

Tools:

- Creation or enhancement of River Parks.
- Creation of corridors of environmental connection between the main naturalistic areas and along the main riverbeds.
- Promote recovery and requalification interventions for riverbeds, watercourses, and estuaries.

Criticality: Excessive load on the wastewater treatment system.

Connected issues:

- Lack of detailed information on the quality and quantity of treated wastewater.
- Lack of information on illegal discharges.

Objectives: Lower levels of microbiological parameters determining the quality of bathing waters.

Tools:

- Requalification of riverbanks to counteract the phenomenon of microbiological pollution in inhabited areas (e.g., with phytodepuration techniques).
- Upgrade non-functioning sewage treatment plants and improve all existing ones.

Agriculture

Agriculture is the second major economic driving force in the project area. Much like tourism, the region relies heavily on agriculture, which generates income and provides job opportunities. At the same time, it has significant impacts on the environment. Among these impacts, the use of large quantities of water for irrigation stands out. It can lead to phenomena such as saltwater intrusion and the dispersion of chemical molecules. The latter subjects the hydrographic network to widespread runoff pollution, potentially increasing eutrophication phenomena in both the network itself and the coastal marine strip.

The system analysis allowed the definition of available data and, at the same time, the identification of a series of indicators selected from the Agri-environmental indicators (AEIs) platform. The choice of indicators was based on two general methodological aspects:

- The indications that emerged during the workshops and the subsequent work carried out during the System Cause-Effect Analysis were prioritised.
- The need to arrive at an effective and immediate description of the impacts generated by agriculture was pursued.

The quality of the implementation of the indicators also depended on the availability of data. The indicators identified for agriculture are:

1) Utilized Agricultural Area (UAA)
2) Percentage of the main types of agricultural land on the Utilized Agricultural Area (UAA)
3) Organic farming
4) Percentage of UAA under organic farming
5) Quantities (q) of fertilizers distributed for agricultural use
6) Quantities (kg) of pesticides distributed for agricultural use
7) Percentage of irrigated UAA
8) Percentage of agricultural enterprises using irrigation

A. Indicators for the Agriculture

1) Utilized Agricultural Area (UAA). The indicator identifies the utilized agricultural area, providing initial quantitative insights into the extent of cultivation within the municipal territory. It also represents the first direct indication of how this significant economic driving force is relevant in terms of land use. Moreover, it indirectly helps pointing out the impacts of agriculture, including irrigation needs and the eutrophication of the hydrographic network. The project area is characterized by strong agricultural features, with the Plain of Sibari being the largest plain in the entire region (**Annex 15**). In the project area, 10% of the regional and 25% of the provincial UAA are located. 58% of the entire project area, corresponding to 51 thousand hectares, is classified as UAA, with significant shares in the most extensive municipalities, Cassano all'Ionio and Corigliano-Rossano, where the percentages of territory covered by UAA are 82% and 56%, respectively (**Annex 16**).

2) Percentage of the main types of agricultural land on the Utilized Agricultural Area (UAA). This indicator is useful for specifying the composition and weight of various categories of crops within the Utilized Agricultural Area. In the glossary of the Common Agricultural Policy (CAP), it is defined as the sum of land used for arable land, permanent grassland, permanent crops and kitchen gardens. The agricultural production showed with this indicator is generally homogeneous across all municipalities in the area (**Annex 17**). Arable land is widely spread, occupying 30% of the UAA. Half of the arable land is dedicated to cereal production, with some qualitative production excellence (e.g., rice cultivation). However, there is a clear predominance of permanent crops, accounting for 57% of the UAA and occupying 33% of the overall project area. The peak is in Corigliano-Rossano, where permanent crops cover 75% of the UAA and almost half of the municipal territory. Going into detail of permanent crops, there is a substantial prevalence of olive and citrus cultivation. Olive cultivation represents 33% of the UAA and 19% of the overall project area. The peak is in San Demetrio Corone, with 52% of the UAA and 36% of the municipal territory occupied by olive cultivation. Citrus cultivation is present to a lesser extent, covering 20% of the UAA and 12% of the total area of the project. The peak is in Corigliano-Rossano, where 36% of the UAA and 21% of the municipal territory is covered by citrus cultivation. There are also productive excellences in this category, such as Amendolara almonds and oranges from Trebisacce.

3) Organic farming (Annex 18). The indicator identifies the cultivated agricultural area using methodologies and techniques of organic farming. Organic farming can be interpreted as a production system that emphasizes environmental protection and animal welfare by reducing or eliminating the use of synthetic chemical inputs such as fertilizers and pesticides. Attention is therefore focused on promoting cultural and agro-ecosystem management practices for crop production and livestock farming.

4) Percentage of UAA under organic farming (Annex 19). The indicator, closely related to the previous one, identifies the percentage of UAA which is cultivated using organic farming methods. The indicator expresses the importance, within the identified productive agricultural areas, of that portion of organic farming which helps reducing potential impacts, maximizing the ecosystem services of the area, and simultaneously contributing to their enhancement. In absolute terms, the municipality with the largest area cultivated using organic methods is Corigliano-Rossano with 5178 hectares, covering 27% of the utilized agricultural area. The highest percentage is recorded in San Demetrio Corone, with 43% of the UAA covered by organic farming. Overall, in the project area, 22% of the utilized agricultural area is cultivated using organic farming practices.

5) Quantities (q) of fertilizers distributed for agricultural use. The indicator provides the quantities of fertilizers distributed, not the amounts used by farmers. It is an indicator of the potential risk of eutrophication, taking place in surface water and coastal areas, coming by the agricultural activities. The quantities of fertilizers (N and P) distributed for agricultural use are indirectly linked to this type of impact. Therefore, the indicator helps understanding how the agricultural production system in is oriented towards reducing chemical inputs, favouring actions that harness the natural fertility of the soils.

6) Quantities (kg) of pesticides distributed for agricultural use. The indicator provides the quantities of phytosanitary products distributed for agricultural use. The monitoring of this indicator serves as an indication of how the agricultural production system in the area is directed towards reducing chemical inputs. It emphasizes actions that leverage ecosystem services, aiming to decrease the dependency on such inputs and highlights the diversity and resilience of the agricultural ecosystem against various pathologies.

7) Percentage of irrigated UAA (Annex 20). The irrigation needs of the project area have been linked, during the system cause-effect analysis, not only to direct pressure on surface water (through irrigation by drawing from watercourses) and underground sources (through well irrigation). They have also been related to some impacts reported by stakeholders. Among these, the main phenomenon is the intrusion of the salt wedge into the coastal areas of cultivated strips. The highest percentage of irrigated UAA is recorded in Corigliano-Rossano and Cassano all'Ionio, where 50% and 37% of the utilized agricultural area is irrigated, respectively. Overall, 33% of the utilized agricultural area in the project area is subject to irrigation.

8) Percentage of agricultural enterprises using irrigation. The indicator categorizes agricultural enterprises in the territory based on the various irrigation systems used, as classified by the Italian National Institute of Statistics (Istat). 41% of the enterprises in the project area use microirrigation, 30% use sprinkler irrigation, and 26% use surface runoff and

lateral infiltration techniques. Submersion, a practice used in rice cultivation, is employed in only 1% of the enterprises in the project area. During the system cause-effect analysis, it was considered more effective to implement an indicator that considers not the number of enterprises but rather the utilized agricultural area. This way, starting from the assumption that the choice of one method over another depends on many factors, including the type of crop, water availability, and soil morphology, it is possible to more accurately assess any potential stress exerted by agricultural practices on water resources. As seen in the previous indicator, 33% of the utilized agricultural area is regularly irrigated. Half of this, 15%, is represented by microirrigation, followed by sprinkler irrigation at 10%, and lateral runoff irrigation at 5% (**Annex 20**).

B. EBM Measures for Agriculture

Applying the ecosystem-based management methodology to the project area implies the identification of a series of measures for agriculture as well. These measures, from the one hand, aim to the preservation of the social and economic integrity of the sector, which are essential in terms of employment and income generation. On the other hand, they are intended for an enhancement of the role of the ecosystem services in functional, structural, and protective terms. In line with the 2010 Protocol on Integrated Coastal Zone Management within the Barcelona Convention, the objectives of the proposed measures are:

- Facilitating sustainable development of coastal areas through planning of agricultural activities. This way, it would be possible to reconcile economic, social, and cultural development with environmental and landscape preservation.

- Conserving coastal areas for present and future generations.

- Achieving sustainable use of natural resources, with particular emphasis on water resources.

- Preserving the integrity of ecosystems, landscapes, and the geomorphology of the coastline.

- Preventing and reducing the effects of natural risks, especially those related to climate change caused by natural or human activities.

- Ensuring coherence between public and private initiatives and all decisions made by public authorities at the national, regional, and local levels that impact coastal areas.

The adoption of these objectives into the project context, along with the activities conducted during the System Cause-Effect Analysis, led to the identification of a series of measures to be shared with local communities. In this regard, the indicators implemented on the ISP facilitated a more in-depth analysis of potential areas for development and intervention in the integrated management of the coastal zone. Efficient governance throughout this participatory process, involving communities, stakeholders, and economic operators, is crucial. This

approach allows agriculture to be viewed as a potentially positive environmental driving force for the area for two reasons:

- Agriculture is an element capable of interacting with ecosystem services. It uses ecosystem services, but it is also able to give back to the environment inputs contributing to its protection and remediation.

- Agriculture can be a promoter of an effective territorial marketing action, based on the local productive excellence.

Criticality: Excessive chemical pollution from agricultural practices and phenomena of water eutrophication.

Objectives:

- Reduction of the use of chemicals in agriculture, with a particular focus on pesticides and fertilizers.
- Containment of soil contamination of heavy metals and other toxic and harmful compounds.

Tools:

- Action on fertilization techniques.
- Actions for reducing the use of pesticides and fertilizers (adoption of organic farming).

Criticality: Erosion and subsidence phenomena; intrusion of the salt wedge.

Objectives:

- Reduction of water resource utilization.
- Improvement of the efficiency of water distribution networks.

Tools:

- Action on irrigation techniques.
- Identification of cultivated species with lower water requirements.

Criticality: Excessive impact on the territory from activities directly related to agriculture.

Objectives: Development or adoption of sustainable agricultural activities to reduce waste and overall pollution.

Tools:

- Actions on waste production, including indirect sources (packaging).
- Actions on transportation vectors.

C. Regulatory Framework for Agriculture

In support of the identified measures for agriculture, there is a fairly articulated range of regulatory instruments:

1. **Containment of pollution from diffuse sources:** This strategic objective in the agricultural sector allows the identification of several possible measures to reduce the impacts in terms of eutrophication of surface waters and the coastal strip. This can be achieved through a series of measures leading to a further reduction in the use of nitrogen and phosphorus fertilizers, whose residues can end up in runoff waters. At the same time, it is possible to additionally reduce the use of pesticides in crops, where residues can be dispersed in the environment, posing a critical issue for the faunal component. In this regard, some regulatory instruments are already active, within which specific objectives and measures can be identified.

- Water Framework Directive 2000/60/EC of the European Parliament and of the Council, October 23, 2000, establishing a framework for Community action in the field of water.

- Groundwater Directive 2006/118/EC of the European Parliament and of the Council, December 12, 2006, on the protection of groundwater against pollution and deterioration.

- Nitrates Directive 91/676/EEC of the Council, December 12, 1991, concerning the protection of waters against pollution caused by nitrates from agricultural sources.

- EU Strategy for the Adriatic and Ionian Region (EUSAIR), 2014.

- Regulation (EU) 2018/848 of the European Parliament and of the Council, May 30, 2018, on organic production and labeling of organic products.

- Legislative Decree April 3, 2006, n. 152, "Environmental regulations."

- Regional Territorial Plan for the Protection and Reclamation of Water in the Calabria Region.

- Regional and interregional basin plans.

- Regional Rural Development Plan of the Calabria Region 2014-2022, in application of Regulation (EEC) 1257/99.

- Integrated production specifications.

- Regional regulatory framework on the "Promotion of development services to the agri-food system."

2**. Containment of erosion and subsidence phenomena:** The specific measures are outlined in the following regulatory references:

- European Water Framework Directive Legislative Decree 152/1999.

- Regional Water Protection Plan under Legislative Decree 152/99.

- Regional and interregional basin plans.

- Regional regulatory framework "Promotion of development services to the agri-food system."

3. Development of sustainable agricultural communities: The objective of developing sustainable agricultural communities in coastal areas is pursued in this sector through a wide range of regulatory tools. These are not instruments specifically intended for coastal areas, but they can have particular adaptations in such zones. Their purpose is to support the development of the multifunctionality of agriculture through training and outreach initiatives, as well as the provision of economic contributions. Special attention is given to enhancing typical and local productions, promoting food and wine itineraries, and utilizing local products in the restaurant industry.

- Rural Development Regional Plan: it implements measures for the infrastructural qualification of rural areas through regular contributions to agricultural businesses, public entities, and consortia.

- Regulations (EEC) No. 2081/92, 2082/92, 2092/91, Legislative Decree 173/98 (art.8), Regional Law XX/XX: all contribute to identifying and enhancing typical and territorial productions. The legislation is in force and includes specific actions for training and dissemination. Regional Law XX/XX promotes the use of quality agricultural products in the restaurant network through the provision of contributions. The actors and recipients of the measures are hotel associations, public canteens, and restaurants. This is a multi-sectoral action involving Agriculture, but also Tourism, Labor, Training, School, and University.

- Law No. 164 of February 10, 1992: it envisages specific actions for creating excellence in local productions.

- Regulations (EEC) No. 2201/96, 1535/03: it is about the concentration of fruit and vegetable productions in the coastal area. It identifies forms of innovation through the development of 4th and 5th range products and health products.

Mediterranean Forum for Integrated Ecosystem Management

The ecosystem-based management of coastal zones requires the ability to collect and organize data characterizing the social, economic, and natural environment. Furthermore, it is crucial to engage in collaborative processing with the stakeholders and the sharing of identified measures. The application of a methodological approach and a standard management software, as outlined in this document, can facilitate the coordination and harmonization of conservation and sustainable development practices. Moreover, it can help promoting dialogue among EBM experts in the Mediterranean area. One of the aims of MED4EBM is, therefore, to enhance and gather the capacities of various stakeholders and institutional actors, with the ultimate goal of establishing a platform for cooperation and coordination to effectively implement ecosystem-based integrated coastal zone management (EB-ICZM).

In this context, within the project activities, the establishment of a permanent structure called the "Mediterranean Forum for Integrated Ecosystem Management" has been envisaged. It is a regional centre for the dissemination of EBM tools and methods. In particular, its purposes are:

- Exchange and interconnection on EBM practices, involving all key actors in the Mediterranean region with experiences in applying such an approach.

- Locally, the Forum aims to engage major stakeholders and institutional actors to systematize various coastal network management methods. Governments, stakeholders, and all other parties involved in the application of the EB-ICZM methodology can use the Forum as a shared platform for making informed decisions on coastal resource planning and management, ensuring effective coordination in the field.

- The Forum should also become a recognized international hub for training technicians, administrators, and stakeholders in the mentioned EBM tools and methods. The goal is for EBM to become a widespread methodology for territorial planning and sustainable development in various concerned areas.

- The Forum will be tasked with promoting partnerships and cooperation with a broad spectrum of public and private stakeholders, civil society, and other entities involved in the management of Mediterranean coastal areas, both at the local and regional levels.

From an organizational point of view, the Forum is based in the Natural Reserves of Lake Tarsia and the mouth of the Crati river, the focal points of EBM implementation in the Italian project area within the MED4EBM project. The launch event of the Mediterranean Forum took place in May 2022 in Sibari, Calabria, marking a significant milestone in establishing its functioning. The conference brought together international experts in ecosystem management, stakeholders, the four project partners, and key actors from local and regional institutions.

The launch event was organized into four sessions:

• Day 1: Introduction to the EBM-ICZM methodology, with examples from international experts on ICZM methodologies and nature-based solutions, such as green and blue infrastructure.

• Presentation of results and experiences in the implementation of EBM-ICZM by the four partners (Italy, Tunisia, Lebanon, Jordan) in their respective target areas.

• In-depth discussion on the objectives, organizational forms, key activities planned for the Forum, and general membership mechanisms. The debate led to the drafting of a statute that will be validated before the end of the project activities.

• Debate on the applied integrated management of the Gulf of Corigliano with a focus on tourism and agriculture, featuring contributions from local institutions (Arpacal, ARSAC, Unical).

From this point forward, the Forum will serve as a permanent hub for the exchange and ongoing sharing of best practices related to EBM-ICZM management. The use and implementation of decision support tools (DSS) are anticipated, serving as facilitators for improved territorial planning that takes into account all dynamics occurring in a specific area.