

# The Development of a Management Plan for the Municipal Ecological Structure: Sesimbra (Portugal) as a Case Study

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## Abstract

In a world increasingly urbanized, management of cities and spatial planning take an important place in political and technical concerns, and it is in this perspective that the Municipal Ecological Structure (MES) arises in Portugal's urban planning system. However, this instrument still struggles with some delimitation, regulation and management issues, that challenge its implementation. In order to overcome these problems, this article wants to explore the designing hypothesis of a Management Plan for the Municipal Ecological Structure (MPMES). To support the plan, this study explores the role of ecosystem services and their potential to provide a vision of the value of Municipal Ecological Structure to the territories, to the people, and as an impulse for local sustainable economic growth. In order to gather insights on the contribution of the management plan for the Municipal Ecological Structure implementation, an approach was made, based on interviews, confronting visions and discourses, by planning experts' contrasts with the stakeholders. Therefore, it was possible to identify, characterize and value the functions performed by the Municipal Ecological Structure of Sesimbra. Ultimately, the objectives, contents, development, approval and articulation with other territorial management instruments were identified as requirements for the Management Plan for the Municipal Ecological Structure development.

**Author Keywords.** Municipal Ecological Structure, Ecosystem Services, Management Plan.

**Type:** Research Article

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## 1. Introduction

The Municipal Ecological Structure (MES) is the set of areas of soil which, by virtue of their biophysical or cultural characteristics, ecological continuity and planning, the main function is to contribute to the ecological balance, the protection, conservation and enhancement of the environment, landscape and natural heritage of the urban and rural areas (Regulatory Decree no 9/2009, 29th of May).

The term Municipal Ecological Structure was first introduced as a legitimate instrument in the Legal Regime of the Territorial Management Instruments (Decree Law no 380/99, 22nd of September changed by Decree Law no 80/2015, 14th of May) and, methodologically, all the Municipal Ecological Structure maps and regulations are approved by the Municipal Master Plans (MMP). However, in most cases, the concept is far from being fully implemented, because there are difficulties in defining, regulating and implementing it ([Correia 2012](#)). In order to overcome these complications, the development of a Management Plan for the Municipal Ecological Structure (MPMES), using the ecosystems services as a tool, could help

fulfill the implementation of Municipal Ecological Structure objectives and contribute to a more sustainable territory.

The main aim of this paper is to recognize the objectives, elements and steps to develop an Management Plan for the Municipal Ecological Structure. To achieve this purpose, it was necessary to understand the evolution of the environmental concerns in planning context, the role of Municipal Ecological Structure in delivering ecosystem services and their integration in management plans, the relevance of the management plan for the Municipal Ecological Structure implementation, and the importance of public participation to identify the functions and values of the Municipal Ecological Structure.

We want to show that a Management Plan for the Municipal Ecological Structure is able to contribute to the preservation and enhancement of ecosystems and their services, providing an opportunity to manage the territory in a sustainable perspective. We addressed this aim in the paper through the development of a qualitative and quantitative methodology based on a review of the literature about the Municipal Ecological Structure, ecosystem services and management plans. We performed thirty interviews between 2013 and 2014 and developed one case study in Sesimbra, Portugal. In what follows Part 2 describes the methodology, Part 3 frameworks the Municipal Ecological Structure, the ecosystem services and the management plans in the context of spatial planning, Part 4 discusses the results of the analysis, Part 5 suggest a framework for the development of a Management Plan for the Municipal Ecological Structure based on the review of the literature and its cross-checking with the results of the interviews and the methodology applied. Finally, Part 6 provides the conclusions.

## 2. Methodology

The methodology followed in this study was divide into three main phases.

Firstly, it was made a literature review showing the evolution of the Municipal Ecological Structure and its legal framework. It was made a review about the concepts of ecosystem services and the management plan too.

Secondly, in order to gather insights on the contribution of the management plan for the implementation of the Municipal Ecological Structure, we followed an approach based on interviews, where we confronted the points of views of the planning experts - eleven members of the technical team that reviewed the master plan of Sesimbra, in the fields of spatial planning, landscape, ecology and nature conservation, transports and mobility - and the stakeholders that use the territory - nineteen stakeholders belonging to the social area, health, environment, municipal associativism, sports and tourism. The interviews had as main aim, to explored and analysed the stakeholders and the experts views, concerning the research need for the Municipal Ecological Structure, its goals, spaces to include in it, its potentialities and its contribution to spatial planning as a tool. However, the content of the interviews was different, we asked specific questions to the experts since they have explicit know-how about spatial planning and its framing.

In the third phase, we were able to locate the areas and functions performed by the Municipal Ecological Structure of Sesimbra due to results from the interviews and calculated the value of each function in order to identify the most multifunctional areas in the territory. We choose the five main functions used in [Cormier, De Lajartre, and Carcaud \(2010\)](#) - ecological, recreational, aesthetic, economic and mobility. We used a geographic information system (GIS) - ArcGIS - to represent the delimitation of each function and the multifunctional dimension of the Municipal Ecological Structure of Sesimbra.

### 3. Literature Review on the concepts of Municipal Ecological Structure, ecosystem services and management plans in the context of spatial planning

#### 3.1. From the evolution of environmental concerns, until the emergence of Municipal Ecological Structure

Changes in land use are among the most important direct drives for the global continuous loss of biodiversity, as well the degradation of ecosystems and their services (Figure 1) (European Commission 2017, 2020; Keesstra et al. 2018; MA 2003, 2005a, 2005b; van den Bosch and Ode Sang 2017; WWF 2020). Concerns for land conservation and the preservation of natural resources date from a speech by George Perkins Marsh in 1847. He drew attention to the destructive impact of human activity on the land of the United States, especially through deforestation (Benedict and McMahon 2006). In Europe, since the Industrial Revolution, and particularly since the 1950s, urbanization has proliferated at an increasing rate (Magalhães 1994), together with transportation infrastructures, tourism development and intensive agriculture (EEA 2009). The integration of open green spaces in spatial planning approaches started in the cities after it was noted how they were growing at a fast pace and with poor living conditions (e.g. noise, air pollution, traffic and lack of green spaces).

Since Olmsted proposed the Parkway concept (Benedict and McMahon 2006; Fábos 2004), during decades, different approaches have integrated urban green areas in spatial planning, focused mainly on the recreational value for the population (Benevolo 2001; Cabral 1993; Lôbo 1995). However, the concerns and approaches have evolved, from the acknowledgment of the environmental and aesthetical aspects by Le Corbusier approaches (Benevolo 2001), to the application of Greenbelts as a natural barrier to the urban expansion (Benedict and McMahon 2006; Mumford 1965). In Portugal, in the early twentieth century, the evaluation of this concept gave rise to the theory of *continuum natural* (Cabral 1993; Telles 1997) aiming to bring nature into the city.

Notwithstanding, the efforts have not been successful in fighting the land use based on soil consumption so, on the last decade of the 21st century, the green infrastructure (GI) approach arises as an "*interconnected green space network that is planned and managed for its natural resource values and for the associated benefits it confers to human populations*" (Benedict and McMahon 2006, 3). The green infrastructure adopts a large and utilitarian view of the multiple functions of the green spaces as a whole, according to the ecosystem services, and assesses the various benefits that each area provides, going beyond an ecological perspective (Silva et al. 2010).

According to Cabral (1980), the concept of ecological structure emerged from the Homeostasis principle of Walter Cannon, 1929 (Cannon 1929). The definition of this concept has contributed to the *continuum naturale* between rural and urban landscape (Cabral 1980). Since 1999, the Portuguese law has foreseen the integration of ecological networks in spatial plans. At a regional level, its scale establishes the Regional Ecological Structure, but it is at a local level that the implementation of the Municipal Ecological Structure by the municipalities is more sensitive, as Municipal Master Plans (MMP) have an increased regulatory power on land use changes. Municipalities are responsible for the Municipal Ecological Structure delimitation and regulation, in continuity with rural and urban areas, adjoining the fundamental systems for the environmental protection. However, the technical concept and the decision about which areas would integrate the Municipal Ecological Structure were only defined in the Regulatory Decree no. 9/2009, 29<sup>th</sup> of May (revoked by Regulatory Decree no. 5/2019, 27<sup>th</sup> of September), and only a few Municipal Master Plans have been revised during

the last decades, so there is still a need to know how to integrate the Municipal Ecological Structure in the territories.

### 3.2. The integration of ecosystem services in Municipal Ecological Structure planning

Nowadays, most people live in cities, turning urbanization into a megatrend expected to continue throughout the world at least until the mid-century, and that has contributed to profound alteration of ecosystems, not just a local scale, but also global (Barnosky et al. 2012; Cohen-Shacham et al. 2019; European Commission 2020; Weith et al. 2020). Thus, it is important to use the ecosystem services approach, in order to preserve the benefits that the Municipal Ecological Structure ecosystems offer to the human well-being (Figure 1).

Ecosystem services (ES) are the benefits people obtain from ecosystems. This definition was derived from other commonly referenced and representative definitions, such as: "ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions" (Costanza et al. 1997, 253).

Research on ecosystem services has grown over the decades (Ash et al. 2010; Braat and de Groot 2012; Costanza et al. 1997; Costanza and Daly 1992; Costanza et al. 2017; de Groot et al. 2012; Gómez-Baggethun et al. 2010; Haines-Young and Potschin 2010; Wallace 2007) and ecosystem services have been categorized in four functional groups, the production, regulation and cultural services, that directly affect people, and the habitat services or supporting services, which are needed to keep the other three (Costanza 2008; de Groot, Wilson, and Boumans 2002; MA 2003, 2005a, 2005b).

Some issues are related with the geographical limitation of ecosystem services. The idea that they do not exist in an isolated way to meet the populations' needs and the difficulty in valuing them are some of the problems that we face today (Haines-Young and Potschin 2010, 2018; Wallace 2007). To solve and overcome these obstacles, we must study the physical characteristics of Municipal Ecological Structure ecosystems, explore the environmental, social and economic relations and use the best planning practices and decision making, in order to reduce the negative impacts of ecosystem services exploration. To achieve this reduction, there should be an ecological continuity in the territory, which would ensure the sustainability and maintenance of functions and services of the Municipal Ecological Structure ecosystems.

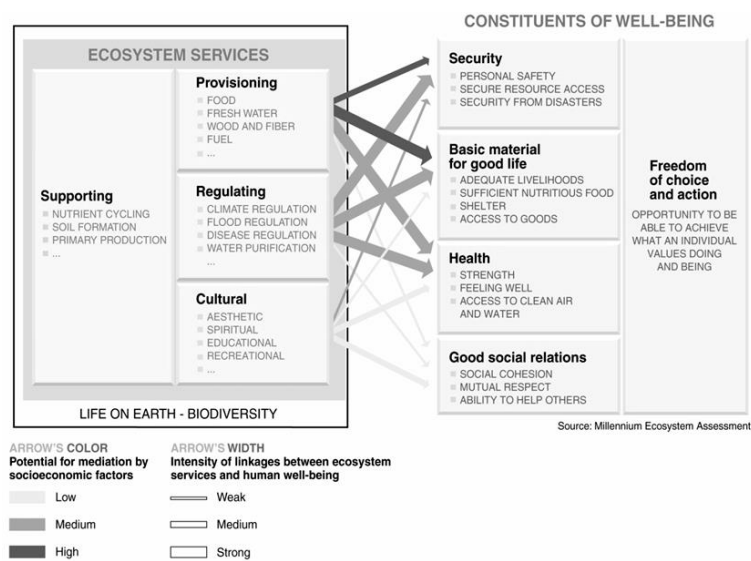


Figure 1: Millennium Ecosystem Assessment overview diagram (MA 2005a)

### 3.3. The role of management plan in Municipal Ecological Structure implementation

Management plan (MP) is a denomination used in different contexts to emphasize the fact that the implementation and management of a planning process, which is complex, can gain in efficiency and effectiveness to streamline the entire wide range of actions, by involving different stakeholders, formalizing the temporal program, and considering the uncertainty of the planning process. Thus, management plan can be defined as a written and approved document that describes an area, its problems and potentialities, and the developing objectives that may be achieved in a defined period of time and at a defined cost (Alexander 2013; BSI 2019; Eurosite 1999, 2004, 2005; Lester 2017; OMNR 2009; PMI 2017).

Management plans must list the phases, main parameters, standards and requirements in terms of time, cost performance and establish several issues to be included in the plan, and in the Management Plan for the Municipal Ecological Structure, as Table 1 shows.

Key question	Answer
Why a Management Plan for Municipal Ecological Structure?	To clarify the strategic thinking about the situation and achieve rationality and coherence in action; To achieve clear objectives and to solve the identified problems; To ensure the adequacy of the objectives and targets chosen for the intervention; To achieve the effectiveness of actions.
Managing what and to whom?	Identifying the resources required for the management plan; Identifying and determining the resources required to achieve the desired goals; Ensuring contracting entities responsible for the management plan for the Municipal Ecological Structure designing.
Who does what, to whom, and with what in mind?	Consider the historical, institutional, social and ideological context of the Municipal Ecological Structure area; Apply an integrated planning that recognizes the complexity of the numerous social, demographic and economic factors that influence the decision and try to integrate them in an analytical and rational process.
How is management exercised and the Management Plan for the Municipal Ecological Structure implemented?	Through the identification of management methods; Defining structuring goals for the plan; Through the analysis of the action programs and their impacts; Comparing and evaluating the options to selecting an operating program; By aiding the proper tools and actions to the management plan for its implementation; Through the review of the plan and its control mechanisms.

**Table 1:** Key issues to consider in the preparation of a Management Plan (Alexander 1992; BSI 2019; Eurosite 1999, 2004, 2005; Lester 2017; Silva 1998)

The issues listed in Table 1 are fundamental to the construction of the management plan, because they:

- Suggest a technical team and stakeholders to monitor and contribute to the plan development;
- Establish agreements and working relationships between Municipal Ecological Structure stakeholders;
- Recommend the definition of the main objectives and the development of a plan which implement Municipal Ecological Structure;
- Allow the decision making and review process; and
- Introduce the adjustment of the Management Plan for the Municipal Ecological Structure over time.

The Management Plan for the Municipal Ecological Structure development should include an ongoing assessment and a monitoring process for its effective implementation.

#### 4. Discussion of Results

Aiming to understand the best way to prepare a Management Plan for the Municipal Ecological Structure, we asked the stakeholders and the planning experts about their opinion about the main goals, advantages, opportunities and functions performed by the Municipal Ecological Structure of Sesimbra.

##### 4.1. The stakeholders' views

A large majority of the stakeholders defined Municipal Ecological Structure as a key instrument to preserve its values and natural areas, and to promote environmental quality as well as people's lives through ecosystems. The remaining stakeholders considered Municipal Ecological Structure as the surrounding area to urban spaces, the protected areas, green spaces and other natural areas. Thus, this spatial planning instrument is vital to allow environmental balance for the sustainability of the municipality due to its multifunctionality, to establish connectivity between rural and urban areas and their ecosystems, and to ensure ecosystem services management due to its strategic vision (e.g. fishing and/or forest).

Stakeholders identified some of the problems of the Municipal Ecological Structure, such as fragmentation of the territory and lack of management to prevent ecosystem services loss. The lack of public participation in the planning processes was nominated as the greatest problem which leads, consequently, to a deficient prevention of the negative impacts on the Municipal Ecological Structure. In order to solve this problem, the stakeholders' group identified some opportunities that can solve or even prevent the negative impacts on the Municipal Ecological Structure (e.g. support nature tourism, preserve and protect natural resources, green modes of transportation - like bike lanes and footpaths - and investments in economic activities that promote the protection of ecosystem services for both populations and other living beings) (Table 2).

Stakeholders' answers			
<b>Definitions</b>	Instrument to preserve natural areas	Improve the quality of the environment and people's lives	Areas surrounding urban spaces
<b>Advantages</b>	Multifunctionality	Connectivity	Strategic vision
<b>Problems</b>	Loss of ecosystem services	Territory fragmentation	Lack of public participation
<b>Opportunities</b>	Natural resources protection	Nature tourism activities	Green modes of transportation

Table 2: Stakeholders' points of view

Most of the stakeholders classified the ecological functions (e.g. carbon sequestration), recreational functions (e.g. recreational and leisure spaces) and the economic functions (e.g. timber production) as the most important functions to safeguard ecosystems sustainability and provide ecosystem services to populations.

##### 4.2. The planning experts' views

The majority of the experts (Table 3) defined Municipal Ecological Structure as an ecological system that is complementary to the human system. Others defined it as all rural (e.g. protected areas) and urban spaces (e.g. areas that include green corridors), or as a planning tool that is articulated with other instruments (e.g. National Agricultural Reserve and/or National Ecological Reserve). According to experts, the ecological function was the most evidenced function (Table 4) performed by the Municipal Ecological Structure (e.g. to maintain the natural continuity between important areas and to preserve and protect the natural resources and biodiversity). Experts identified the same Municipal Ecological Structure



advantages as the stakeholders (e.g. multifunctionality of the spaces, the creation of natural connectivity and its strategic vision). They referred that the Municipal Ecological Structure provide ecosystem services to the cities, notably by promoting recreation, leisure and sports, but also by regulating the biophysical processes, as well as the aesthetical functions. Watercourses, its surrounding areas and the aquifers recharge zones were often mentioned as spaces to include in the Municipal Ecological Structure.

We asked the experts a specific question "What are the main goals necessary for the adequate development of the Municipal Ecological Structure?". We choose to make this question because the experts work to regulate the land uses and the activities that happen on the territories. They pointed out the following goals as the most important:

- The capacity of the Municipal Ecological Structure to articulate the different planning scales, fulfilling the main goals of the Regional Ecological Structure, with corridors and fundamental areas at a local scale, and the creation of a multi-scale network of green corridors (from the transnational to the detailed scale);
- The capability to ensure the sustainability of ecosystems and their resources for Human activity;
- The ability to protect, enhance and restore the landscape values and natural resources;
- The ability to ensure the articulation between rural and urban areas, contributing to the resolution of conflicts of land use;
- An opportunity to define a sustainable mobility;
- A change to encourage the development of a sustainable economic activity through the local gastronomy and tourism activity.

Experts' answers			
<b>Definitions</b>	An ecological system that is complementary to the human system	It is all rural and urban spaces.	A planning tool that is articulated with other instruments.
<b>Advantages</b>	Multifunctionality	Connectivity	Strategic vision
<b>Aims for Municipal Ecological Structure</b>	Multi-scale network of green corridors	Sustainability of ecosystems and their resources	Protect, enhance and restore landscape and natural resources
	Articulation between rural and urban areas	Sustainable mobility	Sustainable economic activity

**Table 3:** Experts' points of view

#### 4.3. Functions performed by the Sesimbra Municipal Ecological Structure

We were able to pinpoint the functions performed by the Municipal Ecological Structure of Sesimbra due to the results from the interviews (Table 4) and, with that, we could calculate the value of these functions based on the stakeholders and the experts' classifications. Then, it was possible to calculate the weighted averages ( $\bar{x}$ ) of each function and their respective weight ( $W$ ). The weight averages were equal to the sum of the interviewees' classifications (Table 4), where the weight was the quotient of the weighted averages for the total number of Municipal Ecological Structure functions. To obtain the value ( $V$ ) of each function, we created the following equation (Formula 1):

$$V = \sum W v(x) \tag{1}$$

where  $V$  is the function value,  $W$  is the weight of the function and  $v(x)$  is the value function, all of these variables were expressed in unit values.

We considered that all functions have the same value and, because of that, we decided that  $v(x)=1$  for all functions performed by the Municipal Ecological Structure of Sesimbra. It was

not the goal of the present study to evaluate the ecosystem services. However, it will be important in future research to calculate the real value of each function based on the valuation of the ecosystem services delivered by the Municipal Ecological Structure.

Functions	Stakeholders classifications					Experts classifications				
	1	2	3	4	5	1	2	3	4	5
Ecological	0	0	0	0	19	0	1	0	0	10
Recreational	0	0	0	0	19	0	0	2	5	4
Aesthetic	0	0	1	12	6	0	2	3	1	5
Economic	0	0	1	2	16	0	0	2	5	4
Mobility	0	0	1	3	15	0	1	1	5	4

**Table 4:** Classification of the functions performed by the Sesimbra Municipal Ecological Structure assigned by the stakeholders and the experts (1 - not important and 5 - very important (Likert, Roslow, and Murphy 1993))

According to stakeholders and experts the ecological and recreational functions are essential for the protection of the natural resources (e.g. agricultural and forest), for the ecological balance and for the conservation and environmental enhancement. They recognized the importance of the mobility function for the territory, however, both groups evidenced the poor quality of the road network, the poor accessibility and the lack of accessibility in public transport in Sesimbra as the main problems that contribute to the low performance of this function. To answer this problem, it will be crucial to implement sustainable modes of transportation (e.g. walking and/or cycling) to enable better performance of the mobility function by the Municipal Ecological Structure of Sesimbra.

Functions	Classifications					$\bar{x}$	W	V
	1	2	3	4	5			
Ecological	0	0	0	1	29	4,97	0,22	0,22
Recreational	0	0	2	5	23	4,70	0,21	0,21
Aesthetic	0	2	4	12	11	4,10	0,18	0,18
Economic	0	0	3	7	20	4,60	0,20	0,20
Mobility	0	1	2	8	19	4,50	0,20	0,20
<b>Total</b>						22,87	1,00	1,00

**Table 5:** Value of the functions performed by the Sesimbra Municipal Ecological Structure

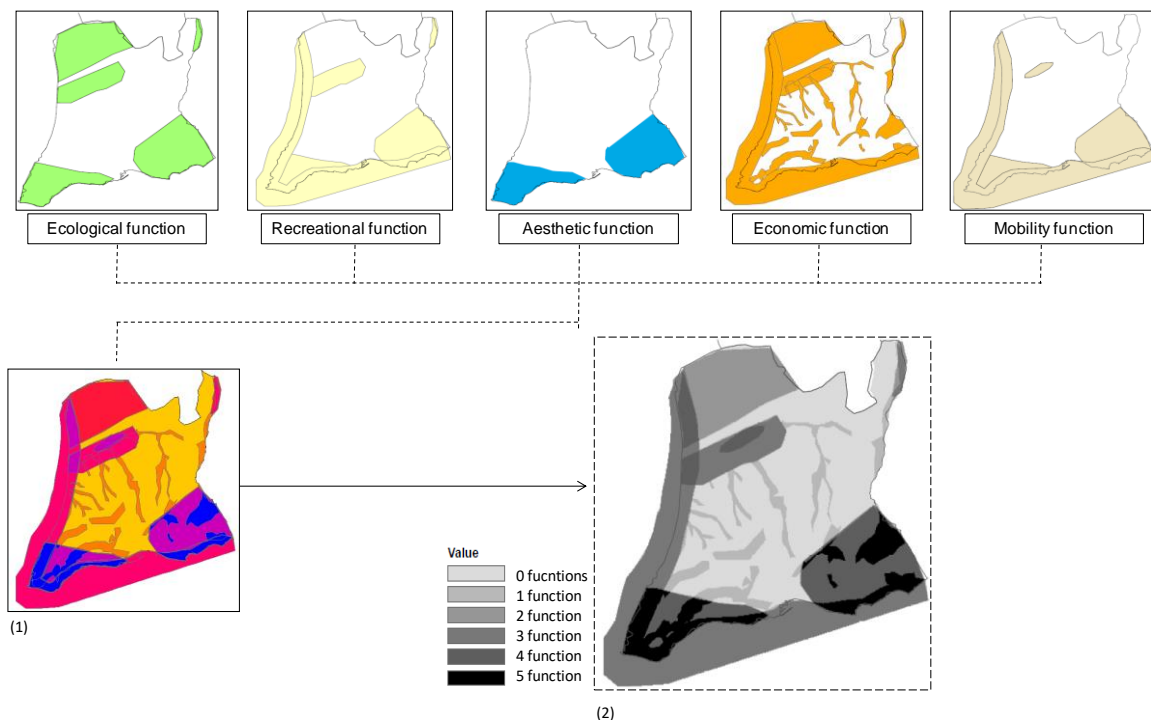
As we can see in Table 5, the ecological function was classified as the most important to maintain in the territory. This function is important to the territory resilience, to ensure the permanent provision of ecosystems services and the maintenance of all biodiversity that is important to secure human life and to mitigate and adapt the areas to the growing climate change phenomena's.

According to the answers from the stakeholders and experts, we were capable of representing on a map each one of the functions performed by the Sesimbra Municipal Ecological Structure. We asked all the thirty interviewees to locate on the map of Sesimbra each one of the functions performed by the Municipal Ecological Structure. Due to the results of the interviews, we were able to locate the five functions (Figure 2). For the ecological function map, the interviewees located the green spaces, Sesimbra forest, Albufeira Lagoon, Arrábida mountain and Arrábida Natural Park. In the recreational function map, they located the green spaces, Arrábida mountain, Arrábida Natural Park, Natural Monuments, Archaeological Heritage sites, Albufeira Lagoon and all the coastline. The Arrábida mountain and Arrábida Natural Park were the spaces located in the aesthetic function map, according to the answers from the interviewees. The Sesimbra forest, National Agricultural Reserve, Natural



Monuments, Archaeological Heritage sites, Albufeira Lagoon and coastline were the spaces located in the economic function map. For the mobility function map, the interviewees located the Arrábida mountain, Arrábida Natural Park, Albufeira Lagoon and all the coastline of Sesimbra.

We used the geographic information system (GIS) ArcGIS to work on each map. For each one of the spaces that provide and offer a function we placed their value of the function value (V) (Table 5) and for the spaces that didn't provide any function, we placed the value of zero. Then we intersected all five function maps with their function value (V) (Figure 2 (1)), did a matrix conversion of the function map and then we obtained a final map that presents the multifunctionality degree of the Sesimbra Municipal Ecological Structure, according to stakeholders and experts answers (Figure 2).



**Figure 2:** Multifunctionality degree proposal for the Sesimbra Municipal Ecological Structure, according to stakeholders and experts. (1) Map resulting from the intersection of the functions; (2) Matrix conversion of functions map

The results showed the multifunctional component of the Municipal Ecological Structure and it was possible to identify the areas with more functions, particularly those with more value (Figure 2 (2)), such as the Natura 2000 Network areas, like the Special Areas of Conservation (SAC) and Special Protection Areas (e.g. Arrábida mountain and Albufeira Lagoon) and the National System of Protected Areas (e.g. Arrábida Natural Park and Costa da Caparica Fossil Cliff Protected Landscape). The Sesimbra forest was also identified as a multifunctional area, where the forestry is articulated with agricultural use and perform ecological functions (e.g. improvement of air quality, carbon sequestration and infiltration of runoff water), economic functions (e.g. forestry and agriculture) and aesthetic functions, for its natural and scenic values.

### 5. Towards Management Plan for the Municipal Ecological Structure

To improve the performance and operability of Municipal Ecological Structure and its functions, as well as the delivery of its ecosystem services, this study suggests the creation of a clause in the legal system that refers to soil regimes, or in the legislation of the Municipal

Management Plan, that obliges municipalities to develop a Management Plan for the Municipal Ecological Structure (MPMES), in case they have their Municipal Ecological Structure elaborate and/or to be approved. We recommend that during the process of plan development, there should not occur any land-use changes in territory while the management plan is not completed, in other words, while there is no collective commitment or policy option about Municipal Ecological Structure, about its main goals and how to achieve them, there can be no public or private transformations in the municipality.

The management's plans for the Municipal Ecological Structure should be planning instruments that may contribute and establish the following framework (Figure 3):

### **Object**

1. The management plan should develop and implement the Municipal Ecological Structure, namely, the set of soil areas that, due to their biophysical and cultural characteristics, their ecological continuity and planning, have as their main function to contribute for the ecological and sustainable balance, for its protection, conservation and environmental enhancement, for their landscape features and natural heritage, both in rural and urban spaces;
2. The management plan for the Municipal Ecological Structure should have as its territorial basis the regional county and can also have an intermunicipal feature;
3. The management plan should provide the Municipal Ecological Structure goals to be achieved programmatically and in conjunction with local communities;
4. The development of Management Plan for the Municipal Ecological Structure should be mandatory.

### **Material content**

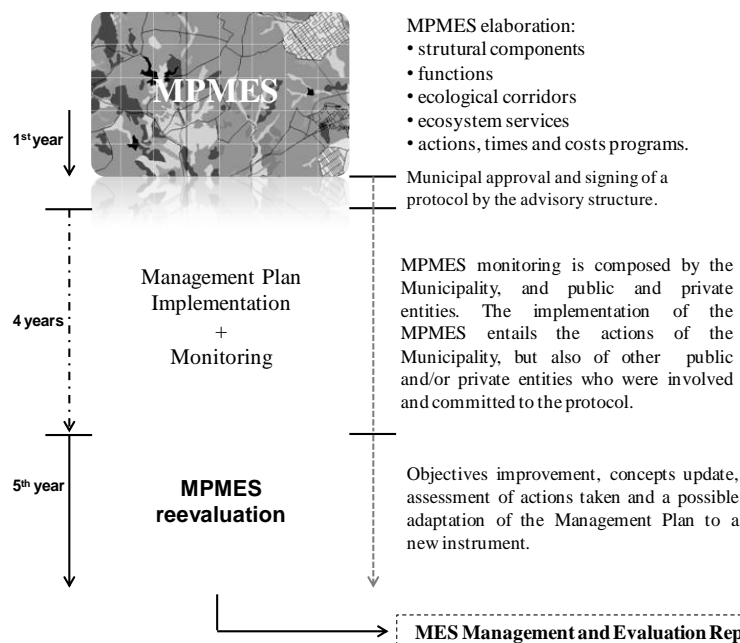
The management plan must adopt the defining criteria for the Municipal Ecological Structure and its goals, establishing:

1. The identification of the structural components of the Municipal Ecological Structure, namely, the spaces to safeguard for protection and enhancement of natural resources, ecological systems and economic activities (e.g. forest areas, areas with natural values, coastal areas, riparian locations, agricultural areas and urban green spaces);
2. The identification and characterization of the functions performed by the Municipal Ecological Structure. This phase should be designed alongside with the administration of the central government and the main stakeholders that are involved in it. It is essential to ensure the processes of ecosystems in order to provide services for the welfare of its population (e.g. hydrological cycle or bioclimatic regulation);
3. Identification and characterization of the ecological corridors for the Municipal Ecological Structure;
4. A data base with the ecosystem services provided by the Municipal Ecological Structure ecosystems;
5. Identify the sensibility levels of the ecosystems, taking into account their protection, their functions and the ecosystem services provided by them;
6. Prioritize the actions, costs, alternatives, time and the budget available to fulfill the Municipal Ecological Structure goals;
7. Identify the management measures needed to mitigate the human impact on ecosystems;
8. Identify the planning and monitoring measures necessary to evaluate the management plan, ensuring an ongoing evaluation process;

9. The elaboration of the management plan should take place during one year, with a description of the components, functions, action priorities, threats and regulatory aspects. After elaboration, the management plan should present a program of actions and a list of the public, private or mixed projects proposed by all the stakeholders involved in the process;
10. There must be a technical and political body for the approval of the management plan alongside the city council;
11. There must be an implementation period and an ongoing monitoring of the plan, after the approval of the management plan;
12. There should be a reassessment of the management plan and publication of a management and evaluation report for the Municipal Ecological Structure, carried out by the city council committee in the fifth year of the management plan, indicating all changes made in the original management plan, the results obtained, and the new objectives and actions provided for the Municipal Ecological Structure management.

### Document content

- 1) The Management Plan for the Municipal Ecological Structure should consist of:
  - a) Regulation;
  - b) Municipal Ecological Structure map with the identification of its functions and ecosystem services.
- 2) The Management Plan for the Municipal Ecological Structures should be accompanied by:
  - a) Reports of public participation;
  - b) A program containing the measures and actions planned for the achievement of the Municipal Ecological Structure goals;
  - c) A management and evaluation report of the Municipal Ecological Structure.



**Figure 3:** The framework for the development of a Management Plan for the Municipal Ecological Structure (MPMES)

## 6. Conclusions

The Management Plan for the Municipal Ecological Structure should be a tool that links all Municipal Ecological Structure uses and occupations to allow its implementation, the

management of its multifunctional spaces and to contribute to the sustainable development of territories. To achieve this, the plan should contribute to an enhanced knowledge of Municipal Ecological Structure, gather its weaknesses and potentials (e.g. analysis that was achieved with the stakeholders and planning experts' interviews), in other words, the plan should contain a diagnosis on Municipal Ecological Structure, containing this and other information before starting the plan development.

It is considered that the Management Plan for the Municipal Ecological Structure development itself, can serve as an opportunity for the involvement of the local community, as well as to a growing sense of responsibility on all the stakeholders to implement it. In this regard, this management plan may be able to promote environmental citizenship. The proposed approach of the management plan development is based on the identification and mapping of ecosystem services. In relation to the mapping procedures, the literature review evidences that there is still the need for further research, not only concerning the ecosystem services identification, but also their multiple interactions. Notwithstanding, it is considered that the conceptual model of ecosystem services applied to planning, could decisively benefit the current approach to the Municipal Ecological Structures, and promote discussion among the possible trade-offs in the territory, contributing to a more sustainable use of its resources and of the urban and rural areas.

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