



Proceedings

# Taking into account the risks identified in the Millennium Ecosystem Assessment: a methodological proposal for the protection of land through the Spanish planning system

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**Abstract:** This study proposes a novel methodology that integrates the “Mapping and Assessment of Ecosystems and their Services” (MAES) project for evaluating ecosystems to protect vulnerable land. By applying it to the Spanish case and adaptable to European States it results in a new regional-scale methodology to better handle natural values, improve environmental data in spatial plans, enable more precise assessments of direct ecosystem pressures, and detect changing impacts. This approach, aligned with municipal spatial planning, provides benefits for the regional level: it matches scale, includes vital environmental data and GIS application to facilitate the integration of ecosystem considerations in planning tools.

**Keywords:** Sustainable development; Ecosystem Services; environmental impact; regional planning; resilience

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## 1. Introduction

This research focuses on territorial resilience and ecosystems, reaffirming their fundamental role in resisting crises and addressing ecological degradation, and outlines the pressures on ecosystems and their impacts, highlighting the need for biodiversity strategies and land-use regulations. As such, the research is in line with the EU Biodiversity Strategy [1], which advocates comprehensive mapping and valuation of ecosystems and their services. In Spain, the National Green Infrastructure Strategy [2] integrates ecosystem conservation and supports mapping planning tools. The study examines the potential of the proposed methodology for high-resolution mapping, analyzes its suitability for conservation regulations, and aims to bridge the gap between land-use planning and ecosystem conservation in the fight against environmental degradation [3].

## 2. Area of study

The proposed methodology is applied to Spain, which, unlike most of European countries, has a decentralized administrative system based on 17 Autonomous Communities (i.e. Regions): this fact has generated diversity in the implementation of tools such as the land-use plans. This peculiarity facilitates the application of the methodology as it enables the planning adaptation to each Region’s characteristics.

## 3. Methodology

The proposed methodology seeks to develop appropriate land conservation arguments that can be applied at both regional and local levels. In contrast to the European Environment Agency (EEA) methodology, this three-step methodology includes land-use

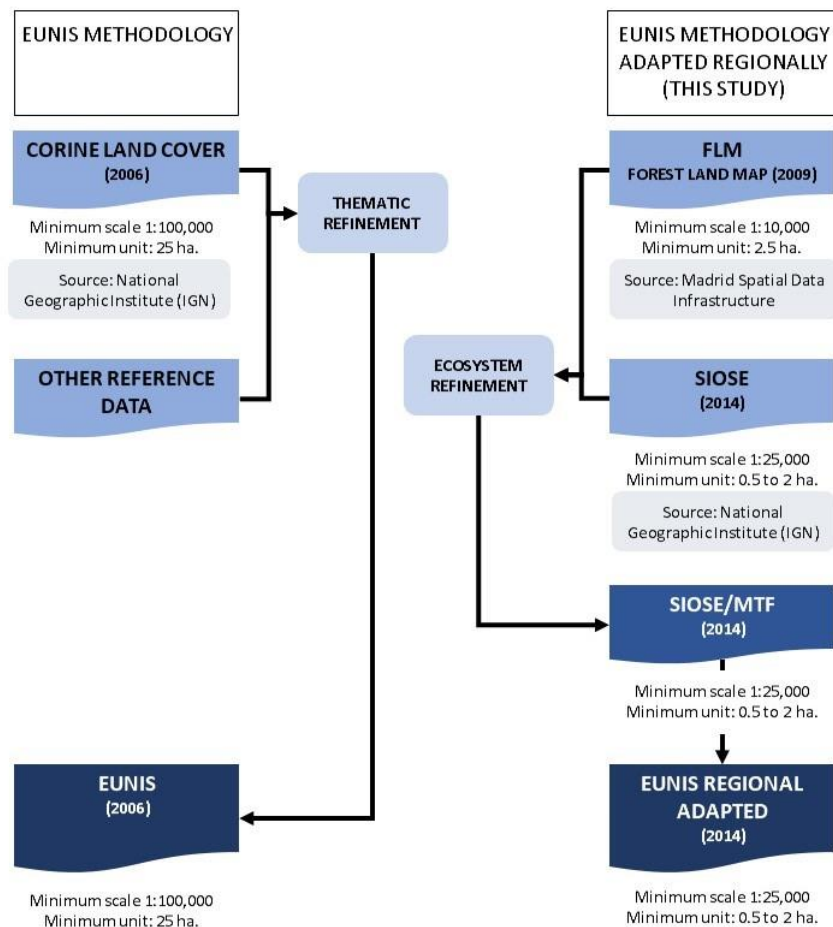
planning as a complementary tool to address future pressures on ecosystems and their services. This requires a compatible working scale (1:20,000) and access to adequate information to make informed decisions.

3.1. MAES and SIOSE: Key Differences in Ecosystem Identification in Europe and Spain

The MAES project provides information on the extent and spatial distribution of key ecosystems, taking into account site-specific conditions due to natural factors and pressures. It proposes a typological classification to compare different parts of the European territory, maintaining a pan-European scale and using regular cartographic data, such as the CLC. The methodology identifies three main groups of ecosystems (terrestrial, marine and freshwater), subdivided into different types, of which the group “I. Terrestrial ecosystems” regards land-use planning at the European level. However, due to its reference scale (1:25,000 vs. 1:100,000) and its ability to define the classification and categorization of the soil for more appropriate decisions in different areas, the SIOSE system is more accurate for the specific case of Spain. This allows a clear identification of the ecosystems in the study area.

3.2. Reclassification and Detailed Definition: Improving Ecosystem Accuracy at Regional Scales

We chose to reclassify the categories of the Spanish Land Use Information System (SIOSE) database. This information, integrated in the National Plan for Territorial Observation, has a larger scale of definition (1:25,000) than that presented by the CLC for its classification of ecosystem types (1:100,000) and complies with the requirements established by the European INSPIRE Directive.



**Figure 1.** Comparison of the EUNIS methodology with a methodological proposal for its adaptation to the regional level. Source: Authors’ elaboration (2023)

The greater definition of SIOSE is achieved through the incorporation of data produced at 1:10,000 and 1:5,000 by the different Autonomous Communities. In this way, a series of coverages are defined, with a minimum representation area of 0.5 ha. in the case of waters, crops, wetlands, beaches, riparian vegetation and marine waters; 1 ha. for urban areas and up to 2 ha. for agricultural, forest and natural areas. In the case of the CLC, this minimum area was set at 25 ha. by default. This greater specificity not only helps to delineate ecosystems more accurately, but also better incorporates elements that divide habitats, e.g. communication or energy infrastructure.

This problem is addressed by comparing our methodological proposal with the similar process that follows the identification and grouping of ecosystems by the European Nature Information System [4]. The result is a map with the same information as its counterpart EUNIS (2006), but with a greater regional definition and updated to the latest monitoring date of the national SIOSE [5]. This base could be updated following the same steps and can be called EUNIS regional map.

### 3.3. Detailed assessment of ecosystems and their services

Once the data source has been selected, the next step is to identify the ecosystem services (ES) of an area and their contributions. This has to be adapted to the mapping at the chosen scale and area. Although the European Nature Information System (EUNIS) is based on information from the CORINE Land Cover Project, for this study and for the reasons mentioned above, the information provided by the Spanish Land Cover Information System (SIOSE) is used as a basis, even though it is less updated than if we were to start from the CLC. Between the two cartographies, there were few changes in land use as a result of the real estate crisis, as shown by the comparison between CLC12 and CLC18. Therefore, the ecosystems would be little altered by the effects of anthropization and other land-use changes that could be reflected in the corresponding land cover. SIOSE map can also be profiled by other regional or sub-regional maps of greater definition or updating. Once this process has been carried out, a new cartography is obtained: here the EUNIS ecosystem units can be assigned in more detail than in the CLC/EUNIS crosswalk. In this case, just as a crosswalk between the MAES, EUNIS and CLC projects has been proposed at the European level, it is methodologically necessary to propose a crosswalk between the SIOSE, CLC and EUNIS projects in order to clearly identify the habitats to map.

Results

The proposed methodology seeks to address five fundamental issues that have prevented overcoming the limitations of scale and precision required to identify ecosystems, their services and their relationship to planning:

- Reference scale. The CORINE Land Cover (CLC) project, due to its European dimension, works with a reference scale of 1:100,000, not very detailed for more regional approximations. This is especially true in reference to the Royal Decree 2159/1978 on "Planning Regulations for the Development and Application of the Law on Land Regime and Urban Planning", which only refers to the minimum scales at which urban land (1:2,000) and land for development (1:5,000) must be represented. This fact leaves the interpretation of Art. 39.2 when it states that the management plans will be "for all the territory included in their scope and at an appropriate scale".
- Minimum mapping unit. In its various updates (1990, 2000, 2006, 2012 and 2018), the detection of land use changes is proposed using 5 ha as the minimum unit of change. However, the minimum unit of the project is 25 ha. This minimum unit related to land use is better treated by other national documentary sources, such as the SIOSE, approaching with a better definition to the territorial reality.
- Hierarchical simplification. The basis on which ecosystems are identified at the European level is based on the CLC. This is not directly adapted to regional information, where certain species are more important and established than at the international level and would be difficult to identify.

- Lack of incorporation of other types of natural information available in the Autonomous Communities and the General State Administration, such as the forest map or urban planning.
- Raster representation of freely available information. The open-access documentation of the European Nature Information System website is in raster format, so it is impossible to adapt it to the local vectorial cartography of national regions, where the resolution of the cell size is not suitable for the analysis with planning tools.

## 5. Conclusion

The Spanish Autonomous Communities regulate land-use planning, taking into account regional differences and respecting the general principles of the State. Regional regulations classify land into urban, buildable and non-buildable categories, influenced by the definitions and motivations of the Autonomous Communities, often based on natural and environmental values. However, the lack of regulation on sustainability criteria leaves land-use decisions to the discretion of political leaders.

Efforts to identify vulnerable areas are critical to preserving land that is labeled as “developable land”. This involves surveying untransformed areas and verifying the presence of ES. Aligning land management with the constitutional principles of subordination of land to the public interest could reconcile economic development with environmental protection, which is essential at a time of population displacement due to climate-related problems.

Reforming environmental assessment procedures, which currently focus on formalities rather than in-depth analysis, is necessary to improve land protection. Integrating ecosystem information into planning processes would align urban development with environmental goals, ensuring effective conservation measures and strategic environmental assessments. The proposed methodology, which works at the regional planning scale, integrates environmental data, and uses geographic information systems, facilitates a streamlined integration of ecosystems into planning and better land protection, improving the quality of information and planning outcomes.

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**Conflicts of Interest:** The authors declare no conflict of interest.

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