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The assessment of the environmental effects in the Strategic Environmental Assessment process: a methodological approach

Strategic Environmental Assessment (SEA) is a well-established procedure to support Decision Makers (DMs) in considering and evaluating the effects of Policies, Plans, and Programs (PPPs) on the environment, along with social and economic considerations, providing a valid basis for informed decision making. The integration of sustainability issues into decision-making processes can be provided in several ways: offering a framework to support DMs in their choice, studying and analyzing alternatives, identifying sustainability objectives, and integrating sustainability criteria in PPPs. In light of such needs, this paper aims to present a methodological approach to guide the assessment phase of environmental effects in the SEA procedure. The proposed methodology consists in seeking a strong and clearly understandable connection between the environmental sustainability objectives deriving from policies at the international level, and the specific environmental sustainability objectives of a Plan, which is propaedeutic to the evaluation of the environmental effects of the Plan itself. Moreover, this approach allows to keep the analysis at the strategic level, which is the one required in SEA. The contextualization of the general objectives of environmental sustainability with respect to the environmental aspects affected by the Plan itself and to the characteristics of the reference territory allows the requirement of strategic relevance to be fully met, integrating policy directions that in some contexts, such as the European one, are not subject to the SEA procedure.

1. Introduction

Strategic Environmental Assessment (SEA) can be defined as a systematic process that allows Decision Makers (DMs) to consider and evaluate the effects of Policies, Plans, and Programs (PPPs) on the environment, along with social and economic considerations, providing a valid basis for informed decision making toward sustainability (Caschilli et al., 2014; Chaker et al., 2006; Sebestyén et al., 2019; White and Nobles, 2013). It improves decision-making through an early introduction of environmental concerns in planning processes (Bidstrup and Hansen, 2014).

The integration of sustainability issues into decision-making processes can be provided in several ways: offering a framework to support DMs in their choice, studying and analyzing alternatives, identifying sustainability objectives, and integrating sustainability criteria in PPPs (White and Nobles, 2013). As highlighted by Frigione and Pezzagno (2023), the role of 'mediator of sustainability' for the SEA is well established in the international literature. In addition, the role of SEA as a tool for practical design, implementation, and alignment of PPPs with Agenda 2030 has become increasingly validated in recent years, to facilitate the achievement of the Sustainable Development Goals (Del Campo et al., 2020; Frigione and Pezzagno, 2023).

In the European Union, the normative reference is the SEA Directive 2001/42, adopted on the 27th of June 2016. The SEA directive was established for Plans and Programs, leaving out Policies, although these usually set the framework for the lower levels, i.e., Plans and Programs themselves (Chaker et al., 2006). The key scope of the SEA Directive is to achieve a high level of environmental protection through the best possible consideration of environmental aspects, while minimizing negative impacts and supporting positive outcomes (Geißler et al., 2023).

Since the introduction of the SEA Directive, theoretical cornerstones and applications of this procedure have been investigated, and the scientific literature has embraced different contexts and fields of research (Caschili et al., 2014). Excluding the practical application papers, which cover a wide range of areas, and focusing solely on the framework and methodological studies, the following key themes emerge as central to the recent: the analysis of participation and how to improve it (Hassanali and Mahon, 2022; Nwanekezie et al., 2021; Partidario et al. 2023), the assessment of cumulative effects (Atkinson and Canter, 2011; Bragagnolo and Geneletti, 2012), the investigation of monitoring and its limitations (Bottero and Mondini., 2020; De Montis et al., 2016; Frigione and Pezzagno, 2023; Gonzalez, 2022), the role of the context and governance (Monteiro and Partidario, 2017; Monteiro et al., 2018; Unalan and Cowell, 2019), and the effectiveness of application (GEißler et al., 2019; Gonzalez et al., 2023; Huang and Li, 2023; Unalan and Cowell, 2019).

In this context, there is a clear lack of works that specifically address methodological aspects, which would act as essential guidelines for the actual impact assessment phase within the SEA.

Proper methodological approaches are crucial as they can increase the quality of informed decision-making, which is one of the key components of substantive effectiveness (Geißler et al., 2019). Moreover, a proper methodological framework allows for overcoming the so-called EIA (Environmental Impact Assessment)-based SEAs, which generally follow the path of EIA and focus too much on technical aspects. This is strictly to be avoided for having a really strategic SEA (Bidstrup and Hansen, 2014), with clearly determined objectives (even in the wide national and over-national scenario), and actions that effectively lead to the intended goals (Noble, 2000).

Given this need, the main objective of this article is to present a methodological approach to guide the assessment phase of environmental effects in the SEA procedure.

In particular, the proposed methodology seeks to establish a strong and understandable connection between the environmental sustainability objectives set at the international policy level (i.e., the "general" environmental sustainability objectives) and those specific to the Plan, as a necessary basis for assessing its environmental effects.

The specific environmental sustainability objectives of a Plan can be identified by "contextualizing" the general ones, in particular considering the environmental aspects affected by the Plan and the characteristics of the area involved. When applicable, it is important as well to consider the results of the monitoring report of the previous Plan.

Therefore, the analysis that led to the definition of the specific environmental sustainability objectives develops from:

1. the general environmental sustainability objectives;
2. the results of the analysis of the environmental context, including the identification of the critical aspects;
3. the indications emerging from the monitoring report of the previous Plan, if any;
4. the environmental aspects to be considered for the assessment, taken from Annex I of Directive 2001/42/EC.

The environmental sustainability objectives of the Plan represent the key to a proper evaluation of its environmental effects. In fact, the environmental effects corresponding to certain actions of the Plan are evaluated in relation to the ability of the individual actions to meet or fail one or more sustainability objectives previously identified.

Once the objectives are defined, the analysis and evaluation of the possible environmental effects of the Plan is conducted through two operational phases. The first phase consists in an analytical evaluation for each individual action, which will be illustrated below. The results of this phase make it possible to have an integrated and overall reading of the actions as a whole. The second phase is the synthesis evaluation: to describe all the effects in an integrated way, a synthetic environmental impact matrix is used, in which the effect of the actions on the environmental factors is reported.

In this way, a path that directly connects the environmental effects deriving from the application of the Plan with the environmental sustainability policies at the international and local levels is defined.

Considering the proposed actual scenario, the primary objective of this paper is to propose a methodological approach aimed at enhancing the assessment phase of environmental effects within the Strategic Environmental Assessment (SEA) framework. This approach is designed to establish a clear and traceable link between international environmental sustainability policies and the specific environmental sustainability objectives of a given Plan. By grounding the assessment in both broad sustainability frameworks (such as those emerging from Agenda 2030) and the specific environmental characteristics of the territory concerned, this methodology seeks to ensure that SEA contributes meaningfully to informed and sustainability-oriented decision-making. The methodology emphasizes the strategic nature of SEA by prioritizing a "context-sensitive" identification of sustainability objectives, which serves as the foundation for evaluating the coherence and environmental impact of the proposed actions within the Plan.

A secondary but equally significant objective of the paper is to demonstrate the practical application of this methodological approach through a case study involving a European Maritime Cross-Border Cooperation Program. This

example is particularly suitable for the application of the methodology proposed, due to the complexity of the Plan - both structurally and thematically - and its involvement of cross-border environmental dynamics, which require alignment with multiple national and European sustainability policies. Through this application, the paper aims to illustrate how the proposed method facilitates a structured, transparent, and integrative evaluation process. However, the methodology can be easily applied to any other Plan or Programme, because the approach is generally structured, and it follows the Directive 2001/42/EC requirements.

The ultimate goal is to reinforce SEA's role as a strategic instrument - not merely a procedural requirement - by ensuring that the environmental effects of planning decisions are systematically assessed against well-defined and contextually grounded sustainability objectives.

2. Description of the methodological approach

The methodological approach proposed in this paper is focused on the SEA of a Maritime Cross-Border Cooperation Program, but it is suitable for being used in any other context as well. Scalability and transferability, indeed, are critical points for guaranteeing the feasibility of the method itself.

First of all, the Program itself was subjected to an analysis of internal coherence among the objectives it contains, and an analysis of external coherence, which considered how the Program stands in relation to other Plans and Programs insisting on the territory object of analysis. The potential alternatives to the adopted choice were also considered, highlighting the positive features of the chosen alternative.

Then, the assessment of the environmental effects started from the delineation of the European environmental sustainability objectives, moving on to the definition of those specific to the Program, and finally to the environmental components and sub-components to be considered in the assessment process. This process will be explained in detail in the following, and it is represented in Figure 1.

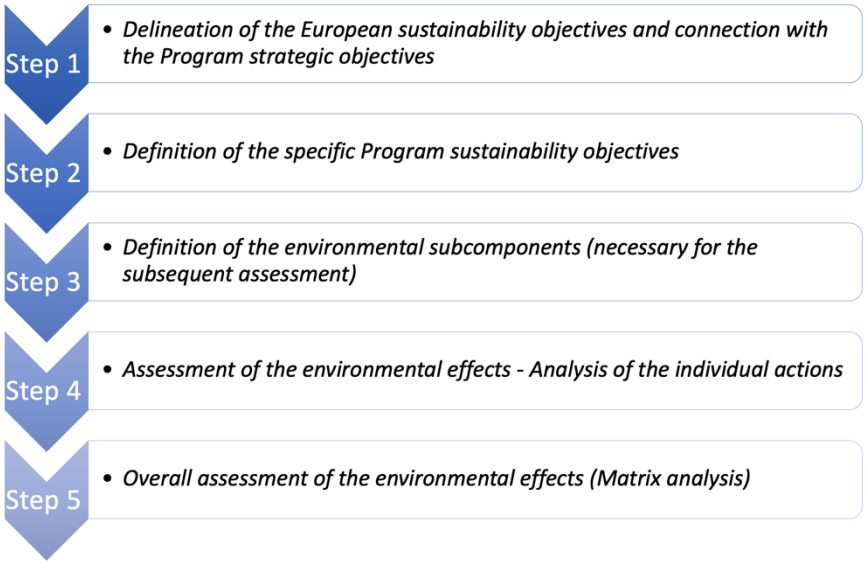

Figure 1. Methodological steps of the SEA approach. The figure outlines the five key steps of the proposed methodology, from the alignment with European sustainability objectives to the final overall assessment.

2.1 Step 1: Delineation of the European sustainability objectives and connection with the Program strategic objectives

At the early stage of the methodology, it is important to assess the level of congruence and connection between the strategic objectives of the program under SEA and the sustainability objectives established at higher levels of planning (international, community, national, and local). Worldwide, the most important reference program is the United Nations 2030 Agenda with its 17 Sustainable Development Goals. At the European level, the implementation of the 2030 Agenda is carried out through the European Green Deal strategy (European Commission, 2019a), which consists of eight thematic macro-areas that correspond to eight goals to be achieved. For each of these, the European Union has developed different implementation strategies. In Figure 2, the different lines show to which of these strategies each strategic objective of the Maritime Program is most connected, highlighting with the thickness of the line the level of intensity in the connection.

With this first step, therefore, the sustainability objectives coming from Agenda 2030 and from the Green Deal were connected with the strategic objectives of the Program.

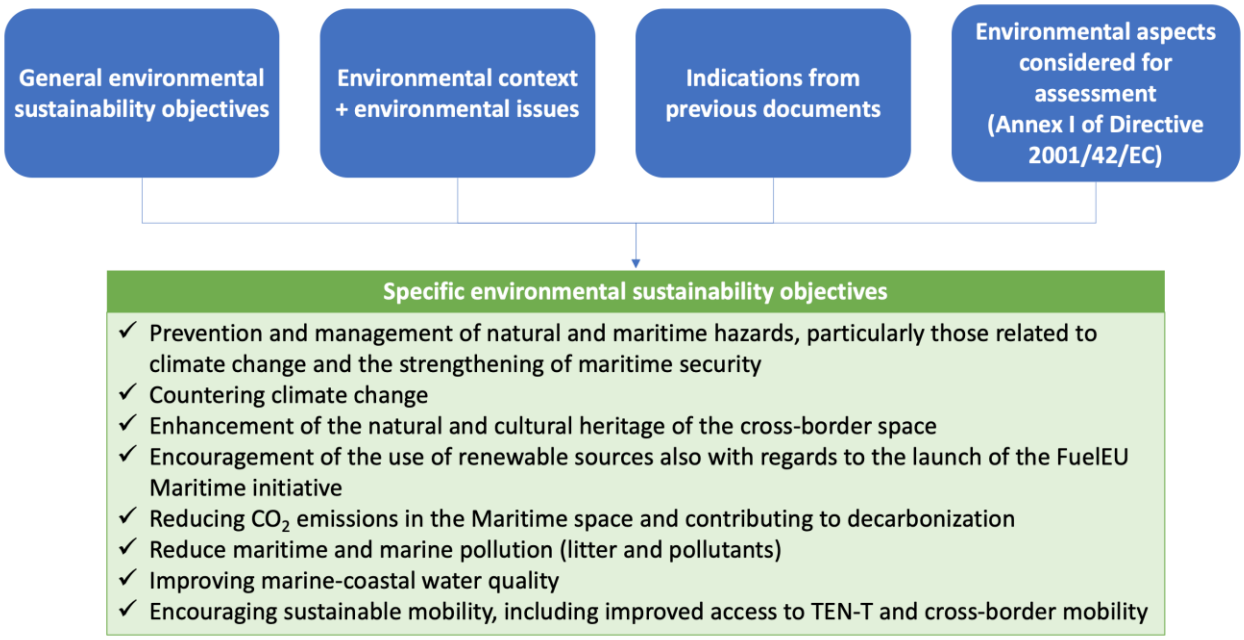

Figure 2. Congruity and connection between 2030 Agenda, the New Green Deal, and derived programming, with the objectives of the Maritime Program. The figure illustrates how the strategic objectives of the Maritime Program (SO1–SO4 and ISO1) are connected to overarching sustainability goals set by the 2030 Agenda, operationalized through the European Green Deal and related EU strategies. The lines indicate the degree of thematic alignment, highlighting the policy coherence and integrated planning logic underlying the SEA process.

2.2 Step 2: Definition of the specific Program sustainability objectives

The second step of the methodological approach consists in the definition of the specific sustainability objectives related to the Program under analysis (Fig. 3). This step is preliminary to the assessment of the environmental effects of the Program.

The analysis leading to the definition of the specific environmental sustainability goals was developed from:

1. the general environmental sustainability objectives identified in the previous environmental protection policy analysis (Step 1);
2. the results of the environmental context analysis, which lead to some critical environmental issues identified (in the SEA procedure, the environmental context analysis is preliminary to the assessment part);
3. the indications emerged from the monitoring report of previous Programs;
4. the environmental reference aspects (or components) considered for the assessment, taken from Annex I of Directive 2001/42/EC of the European Council, aggregated as Water; Air and Climatic Factors; Biodiversity, Flora and Fauna; Soil; Population and Human Health; Material Assets, Cultural Heritage and Landscape.

In the case of the Maritime Program, the environmental context analysis led to the identification of several priorities, particularly connected to the environmental components analysed. For example, for the component Water, "improving marine and coastal water quality" and "reducing marine pollution (in terms of waste and pollutants)" were identified as main priorities. For the component Air and Climatic Factors, instead, the priorities identified were "promoting the use of renewable energy sources", "reducing the CO_2 footprint in the maritime area", and "testing sustainable mobility". This kind of approach was applied to all the environmental components. These priorities were subsequently integrated with the overall environmental sustainability analysis, as well as with the indications emerging from the monitoring reports of previous Programs, and were discussed during the Service Conferences of the SEA procedure. Finally, the specific environmental sustainability objectives derived from the analysis, in relation to the Program analysed were the following:

- Prevention and management of natural and maritime hazards, particularly those related to climate change and the strengthening of maritime security.
- Countering climate change.
- Enhancement of the natural and cultural heritage of the cross-border space.

- Encouragement of the use of renewable sources, also with regard to the launch of the Fuel EU maritime initiative.
- Reducing CO_2 emissions in the maritime space and contributing to decarbonization.
- Reduce maritime and marine pollution (litter and pollutants).
- Improving marine-coastal water quality.
- Encouraging sustainable mobility, including improved access to TEN-T and cross-border mobility.

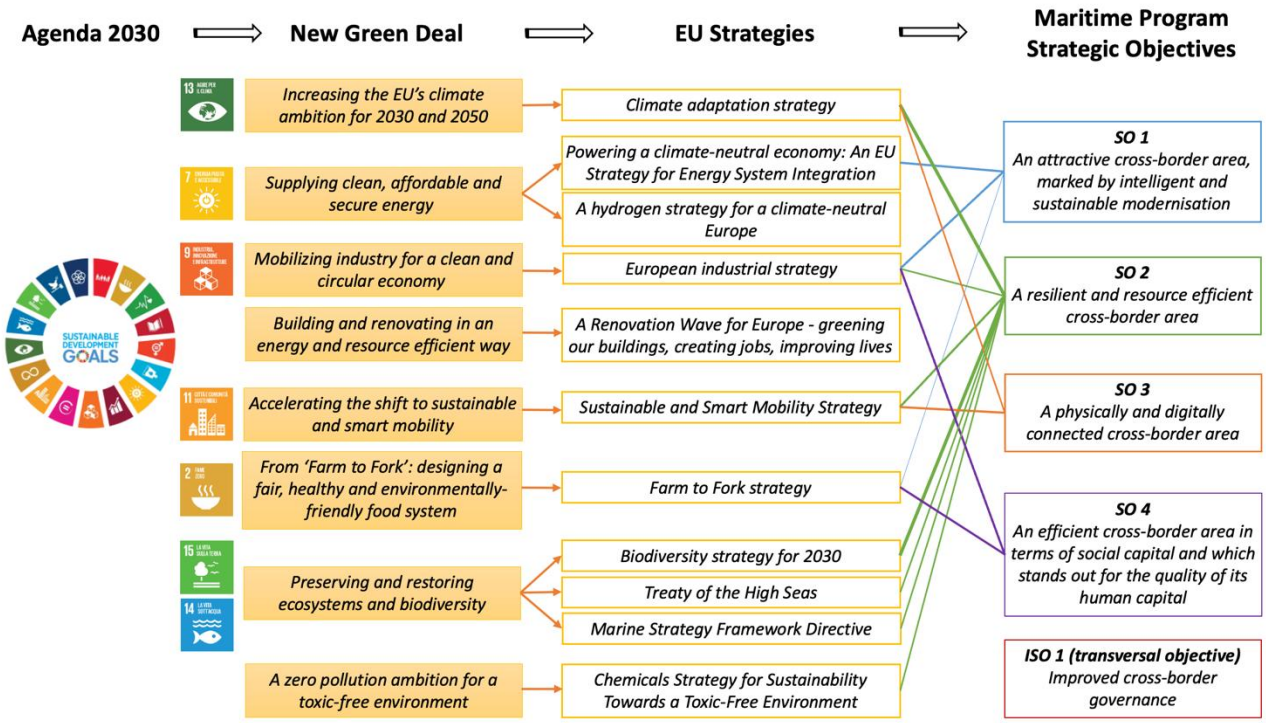

Figure 3. Definition of specific environmental sustainability objectives. The figure shows the process through which the specific environmental sustainability objectives of the Program are derived, starting from the general sustainability objectives, which originate from international policies.

This step is crucial because the environmental effects coming from the Program actions will therefore be identified and evaluated in relation to the ability of individual actions to meet or miss one or more sustainability objectives.

2.3 Step 3: Definition of the environmental subcomponents (necessary for the subsequent assessment)

The assessment of the effects of the Program and the identification of environmental impacts are based on the logical scheme provided by Directive 2001/42/EC; this requires the definition of a series of environmental components and factors as qualifying elements of comparison, in order to highlight the presence of effects - positive or negative, immediate or deferred, reversible or irreversible - on the environment and the territory. These components must be disaggregated in a functional way for the assessment, by considering not only the environmental aspects in a strict sense, but also aspects related to quality of life, such as, for example, effects on human health, on the population, or on cultural heritage. This type of approach also follows the European Union guidelines, according to which sustainability is not a mono-dimensional concept, and proper planning must also consider the relationships between environmental consequences and economic and social aspects.

Therefore, addressing the analysis and evaluation of environmental effects requires the disaggregation of the environmental components (those already mentioned in Step 2) into sub-components to better represent the specific aspects to be evaluated. The definition of components and subcomponents was made on the basis of Directive 2001/42/EC. Obviously, the identified sub-components do not represent all the possible ones for each of the main components. The disaggregation in the different subcomponents (reported in the analysis of Figure 4) was accomplished by considering in particular two different criteria:

- the specific environmental sustainability objectives of the Program;
- the type and content of actions planned in the Program.

The Biodiversity, Flora and Fauna component was left aggregated, without proposing sub-components; the reason for this aggregation lies in the fact that an in-depth analysis must be conducted for those specific aspects in the Appropriate Assessment according to Directive Habitat (43/92 EU).

Figure 4 represents the process for determining the framework of the sub-components, necessary for the subsequent analysis and assessment of environmental effects.

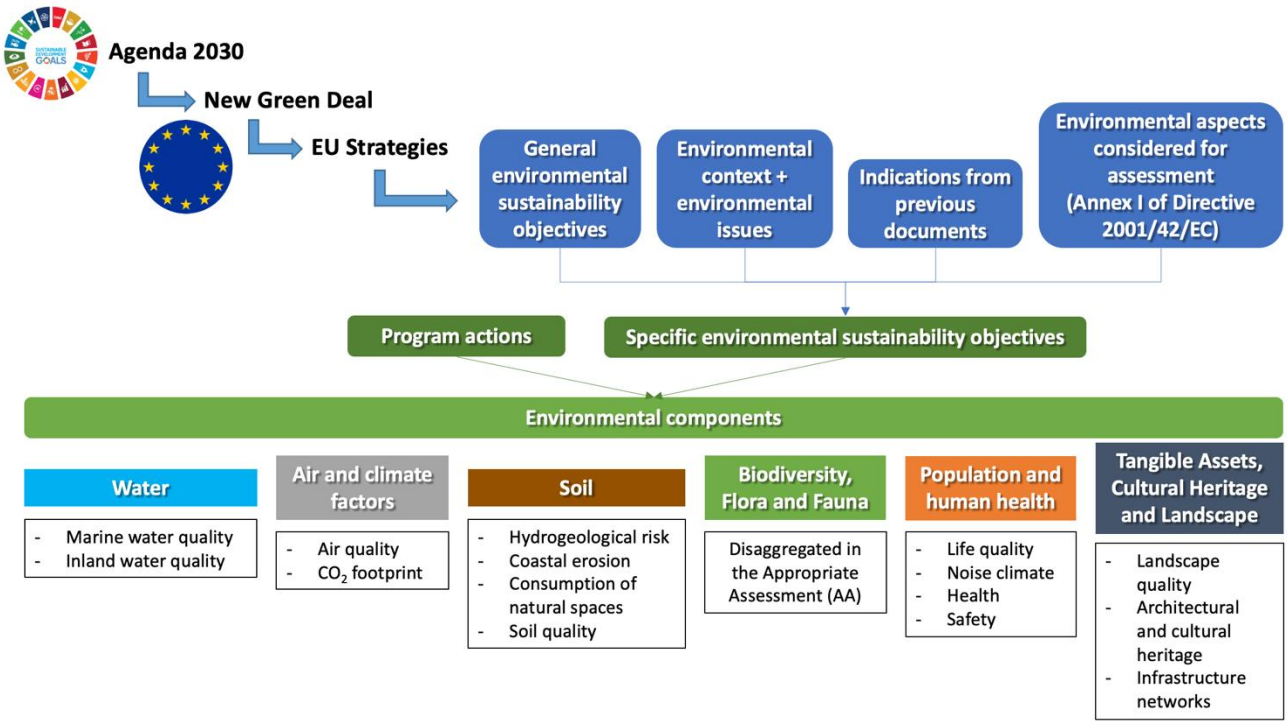

Figure 4. Framework for identifying environmental components and subcomponents for the assessment. The figure presents the process linking international and EU policy objectives, contextual analysis, and program actions to the definition of environmental components. These components are further disaggregated into specific subcomponents to guide the evaluation of potential environmental impacts, in line with SEA Directive 2001/42/EC.

2.4 Step 4: Assessment of the environmental effects - Analysis of the individual actions

The analysis and evaluation of the possible environmental effects of the Program consists of two operational phases. In the first one, analytical assessments are carried out on a per-action basis by preparing an analysis sheet for each Program action. An example of the contents of the analysis sheet is shown in Figure 5. The analysis of individual actions is useful in the detection of specific problems, allowing the identification of more targeted and precise corrective measures, as well as measures to monitor and control situation changes.

Priority (n°)		
Sub-action (n°)		
Objectives and expected results: This section gives a brief reminder of the specific objectives and results expected from the action.	**Brief description of the sub-action:** This section briefly describes contents of the concerned sub-action.	**Expected environmental effects:** This section summarizes the positive and negative environmental effects.
Dispositions to integrate the environmental dimension: This section mentions any provisions for integrating the environmental dimension.		**Environmental indicators additional to those in the plan:** This section provides any environmental context indicators related to the expected environmental effect.

Figure 5. Template for the analytical evaluation of individual Program actions. This table represents the standard structure used to assess each sub-action under the SEA. It includes key sections to report objectives, expected results, environmental effects (positive and negative), and integration of environmental provisions. Additionally, it captures specific environmental indicators beyond those in the Plan. This format ensures systematic and comparable analysis of all actions.

2.5 Step 5: Overall assessment of the environmental effects (Matrix analysis)

In the second operational phase, the results obtained in the analytical assessment by action are evaluated as a whole, in order to describe all the effects with a synthetic and integrated approach. This is carried out through a synthetic environmental impact matrix divided by priority. The matrix reports the effects of the actions or sub-actions, for each strategic objective of the Plan, on the environmental factors (defined in Step 3) likely to be impacted receptors. Part of the symbology for the matrix representation of assessments is the one suggested by Greening Regional Development Programmes Network (GRDPN), in Handbook on SEA for Cohesion Policy 2007-2013 (GRDPN, 2006). This is a SEA handbook for cohesion policies, developed at the European level for 2007-2013 programming, but still highly relevant and applicable to new policies. We chose to use this symbology because it was generally recognized at the European level. Figure 6 shows the legend for this symbology. The main aspects considered for the analysis were the typology of the impact (from large-scale positive to large-scale negative impact), the temporal factor (long-term or short-term impacts), the reversibility or non-reversibility of the impacts, the probability (probable or not probable impact), and the level of uncertainty (impact depending on how the action is implemented). Furthermore, to facilitate an immediate and concise reading of the type of impacts (positive/negative), a colour scale has been adopted for the boxes of the matrix. The colour gradation is explained in Figure 6. The colour provides an added value to the symbology, allowing immediately identifying whether the actions have a positive (green colour), negative (red colour), or absent/not significant impact (white colour).

	Symbol	Meaning
Typology	++	large-scale positive impact
	+	positive impact
	-	negative impact
	--	large-scale negative impact
Temporal factor	> >	effect that occurs in the long term
	>	effect that occurs in the short term
Reversibility	R	reversible effect
	IR	irreversible effect (or reversible only over long time periods)
Probability	!!	very probable effect
	!	probable effect
Uncertainty	?	the possible impact depends on how it is implemented
Color of the matrix boxes		Positive effect
		Not significant or absent effect
		Negative effect

Figure 6. Legend of symbols and colour codes used in the environmental impact matrix. This table explains the symbology adopted for the synthetic matrix analysis of environmental effects. The symbols are derived and adapted from the GRDPN SEA Handbook for Cohesion Policy (2007–2013).

For each action, the evaluation considers both the evolution of the current state in the absence of the program (Scenario T0) and the evolution with the application of the Program (Scenario T1). An example of a matrix is shown in Figure 7.

Priority 3	Water				Air and climate factors				Soil							
	Marine water quality		Inland water quality		Air quality		CO_2 footprint		Coastal erosion		Hydrogeological risk		Consumption of natural spaces		Soil quality	
Action	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
3.3.A.Aa		++ > ? - > ? R				++ > ? - > ? R		++ > ? - > ? R								
3.3.A.Ab		++ > ? - > ? R				++ > ? - > ? R		++ > ? - > ? R								
3.3.B.Ba		++ > ? - > ? R				++ > ? - > ? R		++ > ? - > ? R								

Priority 3	Biodiversity, Flora and Fauna		Population and human health						Tangible Assets, Cultural Heritage and Landscape							
			Safety		Health		Noise climate		Life quality		Landscape quality		Architectural and cultural heritage		Infrastructure networks	
Action	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1	T_0	T_1
3.3.A.Aa		+ > ? - > ? IR						+ > ? - > ? R		+ >> ?						+ >> ?
3.3.A.Ab		+ > ? - > ? IR						+ > ? - > ? R		+ >> ?						+ >> ?
3.3.B.Ba		+ > ? - > ? IR						+ > ? - > ? R		+ >> ?						+ >> ?

Figure 7. Synthetic environmental impact matrix. This figure shows an example of the synthetic matrix used to evaluate the environmental effects of Program actions, referring specifically to Priority 3. Each sub-action is assessed across multiple environmental subcomponents, comparing the baseline scenario (T_0) with the scenario resulting from Program implementation (T_1). Effects are classified using the standardized symbology described in Figure 6.

The example shows the results for one of the priorities identified in the program, and the assessment procedure for some of the actions of the program (3.3.A and 3.3.B, declined in sub-actions). Some environmental impacts (both positive or negative, depending on how the actions will be implemented), with different temporal factors and level of

probability/reversibility, were identified at T1 for the subcomponents Marine water quality, Air quality, CO_2 footprint, Biodiversity, flora and fauna, Noise climate, and Infrastructure networks.

This type of qualitative assessment can be considered sufficient within the context of the SEA procedure, as it nonetheless allows for the identification of the most critical actions in terms of environmental impacts, in relation to the sustainability objectives. The quantitative assessments will then be carried out at a later stage, within the environmental impact assessments of the individual projects envisaged under the Plan. Any uncertainties associated with the qualitative assessments can, in any case, be managed during the monitoring phase of the SEA procedure.

At the end, for each priority, an overall summary assessment is expressed, which considers all actions and sub-actions, even those missing from the synthetic matrices because they produce neither positive nor negative effects but contribute to the overall assessment of the individual priority.

3. Discussion

The role and aims of SEA vary according to the planning and decision-making context in which it is applied (Tetlow and Hanusch, 2012). It has therefore been suggested that SEA should be regarded as a 'family of tools' (Partidário, 2000) or 'a family of approaches' (Dalal-Clayton and Sadler, 2005) and as an 'overarching concept rather than a unitary technique' (Brown and Thérivel, 2000).

It is well known that, to be effective, SEA should start as soon as possible and be fully integrated into the planning process, contributing to every stage of decision-making. Significant environmental impacts should be assessed and taken into account when developing and approving the Plan or Program. Therefore, SEA should be part of the decision-making process, and proper methods that fit its goals and procedural nature should be developed (Jessel, 2005). There is a need to clarify any methodological uncertainties and strengthen the practical application of appropriate SEA methods (Lee and Walsh, 1992). That is the reason why our work was focused on a methodological approach, able to enhance the substantive effectiveness of SEA and ensure the success of its practical implementation.

The different steps of assessing the environment within such a decision-making process have to be built upon each other in a coherent way, and it has to be decided carefully at which process level certain matters are evaluated most appropriately (Jessel, 2005). The need for a strict connection with environmental sustainability objectives deriving from policies at international level is surely prescribed by the SEA Directive; indeed, the Directive states that SEA should also look at "the environmental protection objectives, established at international, Community or Member State level, which are relevant to the Plan or Program and the way those objectives and any environmental considerations have been taken into account during its preparation". Identification of these objectives will provide the basis for evaluating the significance of impacts in the following stages of SEA. In this context, the added value of the methodology proposed in this work lies in considering policy-derived objectives not separately, but in an integrated way that is closely linked to the impact assessment phase.

Environmental objectives provide a benchmark "intention" against which the environmental effects of the Plan can be tested. They may often be similar to measures contained in the Plan/Program (P/P) or derive from objectives that may exist in other related P/P (Scott and Marsden, 2001).

Then, when predicting the impacts of the Plan/Programme based on the environmental objectives, once the expected outcomes have been identified, it becomes possible to assess their potential implications for the environment. What is important is to provide as much information as possible about what is expected to happen in the environment as a consequence of implementing the P/P (Scott and Marsden, 2001). Predictions should address:

- the nature of the change (e.g. a decline in air quality, loss of landscape or ecological resources, reduction in amenity, impact on soils or water resources);
- the extent of the changes, described as far as possible;
- the geographic location or extent and the frequency and duration of the impact;
- whether the impact may be temporary or permanent; and
- the probability that the impact will occur.

According to this approach, in our effects-assessment matrix, we chose to adopt part of the symbology from the Handbook on SEA for Cohesion Policy 2007–2013, as it allows the above information to be represented quickly, clearly, and effectively. The symbology employed allows for taking into account different aspects simultaneously, including the typology and amount of the impact, the temporal factor, the reversibility and probability aspects, as well as the level of uncertainty. This methodology, therefore, avoids an overly simplistic evaluation.

In relation to other methodological works that can be found in the literature, Dalal-Clayton and Sadler (2017) proposed a methodology for reviewing the quality of SEAs and identifying problems associated with them, particularly in the context of development cooperation. The methodology is based on internationally accepted principles and good practice, and it uses a question-based approach. It includes three modules that separately assess the main aspects of SEA:

compliance with requirements, technical quality, and usefulness. The framework provides key criteria and supporting questions that can be used to review the overall quality of SEA and help improve practice.

Similarly, the work of Zhang et al. (2020) analysed the concept of effectiveness of SEA. Questions were examined, such as how effectiveness is defined and how the critical factors affecting it are determined.

These works, therefore, focus on the methodology for reviewing the quality and effectiveness of SEAs (and the difference between the two concepts) rather than on the methodology for conducting the evaluation of the impacts within the SEA process.

Chaker et al. (2006) offered a comparative overview of SEA systems in 12 countries, examining their legal, institutional, and procedural features. With regard to the types of impacts included in their methodological approaches, seven countries considered sustainability issues within the scope of SEA (the Czech Republic, Denmark, the Netherlands' E-test, New Zealand, Portugal, South Africa, and the UK). Among these, the Czech Republic, Denmark, New Zealand, and South Africa also required an assessment of how strategic decisions affect health and cultural heritage. The remaining countries focused only on environmental impacts. This variability in the range of impacts considered reflects how each country defines "environment", whether it is seen narrowly as the biophysical and chemical surroundings, or more broadly as everything that influences human environment, quality of life, and sustainable livelihoods, including socio-economic factors.

It is clear that researchers and technicians need to focus on proper methodologies for the analysis and evaluation of the effects, in order to shorten the working time for the construction of the environmental reports, and to make the SEA process as efficient and effective as possible.

Lastly, transferability, scalability, and reproducibility are essential qualities for methodological approaches in Strategic Environmental Assessment, although often ignored (João, 2007). They are particularly crucial in ensuring method applicability across diverse planning contexts and governance settings (Monteiro et al., 2018). A transferable, reproducible, and scalable method can be adapted to different territorial and institutional frameworks while maintaining its analytical coherence and alignment with SEA objectives (Partidário, 2012), knowing that SEA capacity is 'context-influenced' and dependent on the governance contexts (Monteiro et al., 2018). Thus, proper methodologies need to be able to flexibly respond to different sets of problems at different scales. In this sense, the proposed methodology has a structure capable of being applied to any other territorial context, and also to any other institutional scale (broader or more local).

4. Conclusions

It is essential to apply appropriate and rigorous methodological approaches to enhance the substantive effectiveness of SEA and ensure the success of its practical implementation. The analysis of the state of the art has highlighted a lack of work that deals more specifically with methodological aspects and the need to have adequate methodological paths for the drafting of the environmental report, with particular attention to the phase of analysis and evaluation of environmental effects. This paper contributes to filling such a gap by providing a simple but coherent methodology for assessing the significant environmental impacts of Plans and Programs, in coordination with the overall environmental policy objectives. As part of the decision-making process, SEA should be based on a sound information system for the assessment. In this paper, we proposed a straightforward and meaningful assessment framework, consisting of two operational steps, one more analytical and one synthetic, to arrive at an overall environmental impact judgment.

The proposed approach was applied to a case study, that of the European Maritime Cross-Border Cooperation Program, but it can be easily applied to any other territorial context or level, having a structure that allows for transferability and scalability. The approach starts from the reference objectives of the Plan/Program to ensure that the strategic dimension of SEA is preserved and strengthened; otherwise, there would be the risk that SEA could be reduced to a set of practical considerations, less grounded in its theoretical and methodological foundations.

The Directive 2001/42/EC on the assessment of the effects of certain Plans and Programs on the environment, in Annex 1, describes the contents of the Environmental Report. Regarding the contents to be provided, letter e) asks for providing information on the environmental protection objectives, established at international, Community or Member State level, which are relevant to the Plan or Program and the way those objectives and any environmental considerations have been taken into account during its preparation.

This is normally done, but in many cases, it remains a separate chapter, which is not connected with the phase of the impact assessment. However, the "Commission staff working document executive summary of the evaluation of the Directive 2001/42/EC on the assessment of the effects of certain Plans and Programs on the environment (European Commission, 2019b), reiterates that "since the SEA Directive is cross-cutting, it is a flexible tool which, when properly applied, will help to implement key EU policy actions and to achieve the Sustainable Development Goals". To ensure governance fully capable of achieving a high level of environmental protection, as required by the SEA directive, a

Plan/Program must be able to translate political and legislative guidelines—at international, national, and local levels—into concrete, applicable practices within the territories or sectors affected by planning.

This is the reason for our approach, trying to build a connection between policy, legislation, and assessment, giving therefore also significant results in terms of achievement of the sustainable development goals.

The methodology proposed in this paper offers a coherent and practical framework for assessing the environmental effects of Plans and Programs. However, some potential limitations should be acknowledged. The first one is linked to the quality and availability of baseline environmental data and the clarity of the general and specific sustainability objectives, which may have consequences on the effectiveness and quality of the analysis. This aspect may be interlinked with the scalability issue. While at the national and regional levels quality of the baseline data is generally sufficient or good, some limitations in data availability may arise for the local scale.

Furthermore, the operational steps, while straightforward in theory, may face difficulties in capturing complex interactions among environmental factors, especially in a dynamic or multi-sectoral planning context. Additionally, as the method emphasizes the need for anchoring assessment in strategic policy frameworks, it may require a level of technical expertise and interdepartmental coordination that is not always available within planning authorities. Therefore, also a strong institutional support, capacity building, and stakeholder engagement should be needed.

Further developments of this work could involve the application of the methodology to other territorial and/or institutional contexts; moreover, the approach could benefit from the integration with other tools, e.g., geographic information systems, or multicriteria analysis.

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