Strategic Environmental Assessment as a tool to mainstream ecosystem services in planning[1]

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1. Introduction

What is Strategic Environmental Assessment?

Strategic Environmental Assessment (SEA) refers to a "range of analytical and participatory approaches that aim to integrate environmental considerations into policies, plans and programmes and evaluate the interlinkages with economic and social considerations" (OECD, 2006). SEA applies primarily to development-related initiatives promoted individually in sectors (e.g., transport, energy, water, tourism), or collectively in a geographical area (e.g., regional spatial or land use plan). The field of SEA has developed rapidly over the last 15 years, and SEA is undertaken, both formally and informally, in an increasing number of countries and international organizations (Sadler, 2011). Two EU-led initiatives promoted the application of SEA. Firstly, the European "SEA Directive" (2001/42/EC), which requires an environmental assessment for certain plans and programmes at various levels (national, regional and local) that are likely to have significant effects on the environment. Secondly, the SEA Protocol to the Espoo Convention (UNECE Convention on EIA in a Transboundary Context), agreed in 2003, which encourages the use of SEA in the context of policies and legislation (OECD, 2006). Currently, several dozen countries around the world have either national legislative or other provisions for SEA, e.g. statutory instruments, cabinet and ministerial decisions, circulars and advice notes. Increasingly, developing countries are introducing legislation or regulations to undertake SEA, or are applying SEA-type processes (Sadler, 2011).

Even though SEA approaches vary in different countries, for different sectors and for different levels of decision-making, there is broad agreement on certain defining principles (Therivel, 2004):

- SEA is a tool for improving strategic actions. Hence, SEA should start early, and be undertaken as an integral part of the decision-making process. Decision-makers should be involved in the SEA process to ensure that proper considerations is given to SEA findings;
- SEA should promote stakeholders participation and ensure transparency in the decision-making process, including sensitivity to gender;
- SEA should focus on key environmental and sustainability concerns that are appropriate for the specific strategic action, considering the timescale and resources of the decision-making process. A scoping stage is always important to sort out the key issues;

[1] This chapter draws on the guidance manual "Integrating Ecosystem Services in Strategic Environmental Assessment: A guide for practitioners" produced by the author for the UNEP's GEF-funded "Project for Ecosystem Services", implemented by the Ecosystem Services Economics Unit, DEPI-UNEP. Different versions of this chapter, based on the same guidance manual, appeared in the Journal of Environmental Assessment, Policy and Management (Geneletti, 2015a) and in the Handbook of Biodiversity and Ecosystem Services in Impact Assessment, Edward Elgar Publishing (Geneletti, 2016b).

- SEA should include the analysis and comparison of possible options for the strategic action, and the identification of the most suitable one(s);
- SEA should aim at minimizing negative effects, enhancing positive ones, compensating for the loss of valuable features and benefits, and ensuring that irreversible damage are not caused. This requires predicting the effects of the strategic decision, and comparing the likely future situation without the action (the baseline) against the situation with the action. It also requires to evaluate the significance of the effects.

In short, a good-quality SEA process informs planners, decision makers and affected public on the sustainability of strategic decisions, facilitates the search for the best alternative and ensures a democratic decision making process (IAIA, 2002).

There are several reasons why SEA is important, including (after Partidario, 2012; Sadler, 2011; Abaza et al., 2004):

- Promotes environmentally sound and sustainable development, shifting from a "do least harm" to "do most good" approach;
- Allows problems of environmental deterioration to be addressed at their "upstream source" in policy and plan-making processes, rather than mitigating their "downstream symptoms" at project level, extending the principles of Environmental Impact Assessment;
- Provides early warning of large-scale and cumulative effects, including those resulting from a number of smaller-scale projects;
- Facilitates identification and discussion of development options and provides guidelines to help development to follow sustainability trajectories;
- Encourages political willingness, stimulates changes to mentalities and creates a culture of strategic decision-making.

For these reasons, SEA is considered one of the most promising tools to integrate environmental concerns into strategic decision-making, and more broadly to help facing development challenges (World Bank, 2009).

How is SEA applied?

SEA must be flexible and able to adapt to the planning and policy-making context (including legal, institutions, procedural and political factors), which may be very different among countries, decision tiers (national, regional, etc.), and sectors (land use, agriculture, water, energy, etc). Additionally, the specific circumstances of the strategic action under consideration (in terms of content, level of definition, availability of data, timing, consultation with stakeholders, etc.) will determine the way in which SEA is undertaken. Therefore, SEA can be applied in various ways to suit particular needs. For example, some SEA (OECD, 2006):

- Are "stand-alone" processes running parallel to core planning/policy processes, while others are integrated into them;
- May focus on environmental impacts, while others integrate all three dimensions of sustainability: environment, social and economic;
- May engage a broad range of stakeholders or be limited to expert policy analysts;
- May consist of a quick analysis in a short time frame while others require detailed analysis over a long period;

- Can be a finite, output-based activity (e.g. a report), or a more continuous process that is integrated within decision-making, focused on outcomes, and that strengthens institutional capacity.

In the light of this, a number of methodological approaches have been proposed over the years to tailor SEA to different decision-making contexts, and to show the broad range of possible SEA forms (e.g., some are more focused on the assessment of impacts, others on institutions and strategic thinking). Even though SEA cannot be represented by a standard sequence of activities, the SEA principles described earlier allow to identify a number of typical stages through which SEA can feed decision-making. Figure 1 presents the SEA stages associated to the broad stages of strategic decision-making. In reality, decision-making seldom follows this idealized model, hence SEA needs to operate under different conditions and be flexible. More details on the activities to be performed under each stage, and on possible variants, can be found in OECD (2006), Fischer (2007), Ahmed et al (2008), Therivel (2010), Partidario (2012).

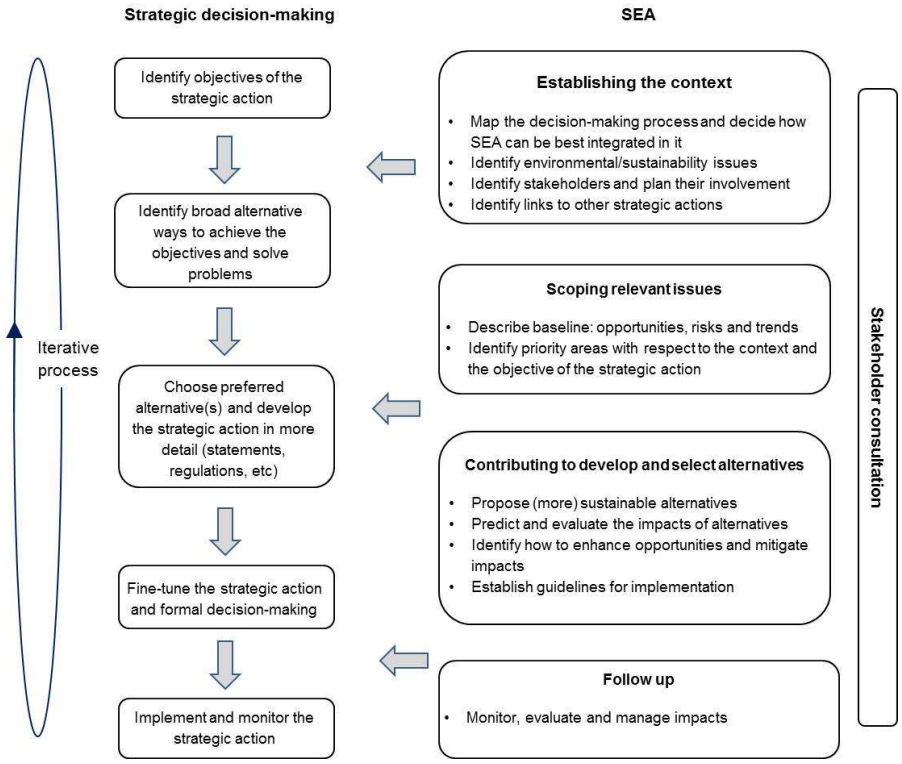

Figure 1. Strategic decision-making and SEA stages. Source: Geneletti (2015) (building on Therivel, 2004)

2. Ecosystem services in SEA

The MA (2005), as well as many other studies that followed, highlighted the importance to integrate ecosystem services (ES) into strategic decision-making, so that the effects of certain development options on ecosystems, and the services they provide, can be considered at the earliest appropriate stage. SEA is potentially a very suitable tool to achieve this because - as described in the previous sections - it focuses on strategic actions, promotes stakeholder engagement, and helps facing broad development challenges. Additionally, the content of SEA is increasingly extending beyond the biophysical environment to include also other issues (social,

health, economic) associated to human wellbeing. Typically, policy-makers are interested in knowing how the costs and benefits are shared by the stakeholders of society in execution of policies. The concept of ESs is a viable tool for impact assessments, as it provides a means to translate unattended and unintended consequence of policy implementation on human well-being (Kumar et al., 2013).

The use of the ES concept in SEA also offers the advantage of presenting a more holistic and integrated consideration of the socio-ecological system, and an effective framing of the (natural) environment in terms of communicating with and influencing stakeholders and decision makers (Baker et al., 2013). ES can be appropriate indicators to weight impacts of developmental policies, programs and plans on the state of environment, which is the basis for providing natural capital. Using ES as indicators could help ensuring that appropriate considerations are given to the implications of environmental impacts, when introducing new developments. Table 1 summarises the possible contribution of ES to good-quality SEA.

Table 1. Examples of contributions of ES information to the quality of SEA. Source: Geneletti (2011)

Characteristics of good-quality SEA (IAIA, 2002)	**Contribution of ES information**
Integrated	ES inherently address the interrelationships between biophysical and socio-economic aspects. The analysis of ESs-related scale issues facilitates the interaction with relevant plans and policies at different decision-making tiers.
Sustainability-led	ES approaches explicitly link changes in ecosystems and biodiversity with effects on human wellbeing. Hence, ES-inclusive SEA processes extend beyond the assessment of biophysical and environmental factors only, and promote plans that are more sustainable.
Focused	ES approaches offer a key to read the most important interactions between human society and the environment, identifying issues that are important for the specific decision-making context.
Accountable	Analysis of expected future trends in ES under different scenario conditions can be used to document how sustainability issues were taken into account, and to justify planning choices.
Participative	Information on ES by definition requires the identification of beneficiaries and stakeholders (including by gender), paving the way to more participative SEA processes.
Iterative	The analysis of ES can be included, in different forms, throughout the whole process, so as to provide information on the expected impacts of plan's choices during the different "decision windows" of the planning/policy-making process.

There is a growing interest in the potential of SEA, and impact assessment in general, to mainstream ES concerns in decision making, as shown by recent scientific publications (Mandle et al., in press; Geneletti, 2016a; Geneletti et al., 2015; Geneletti, 2013a; Karjalainen et al 2013) and reviews of practices (Rosa and Sanchez, 2015; Honrado et al., 2013). Experiences in this field have begun to emerge in the last few years (Partidário and Gomes, 2013), showing the need for comprehensive guidance (Helming et al., 2013). This chapter addresses this need by proposing a methodological approach structured into a set of key stages and tasks to integrate ES effectively in SEA, focusing particularly on the planning level of decision-making.

Building on the general SEA stages presented in Figure 1, the approach is structured in the following four stages, each comprising specific tasks (Figure 2):

- Establish the ES context (Stage 1).
- Determine and assess priority ES (Stage 2).
- Identify alternatives and assess impacts on ES (Stage 3).
- Follow up on ES (Stage 4).

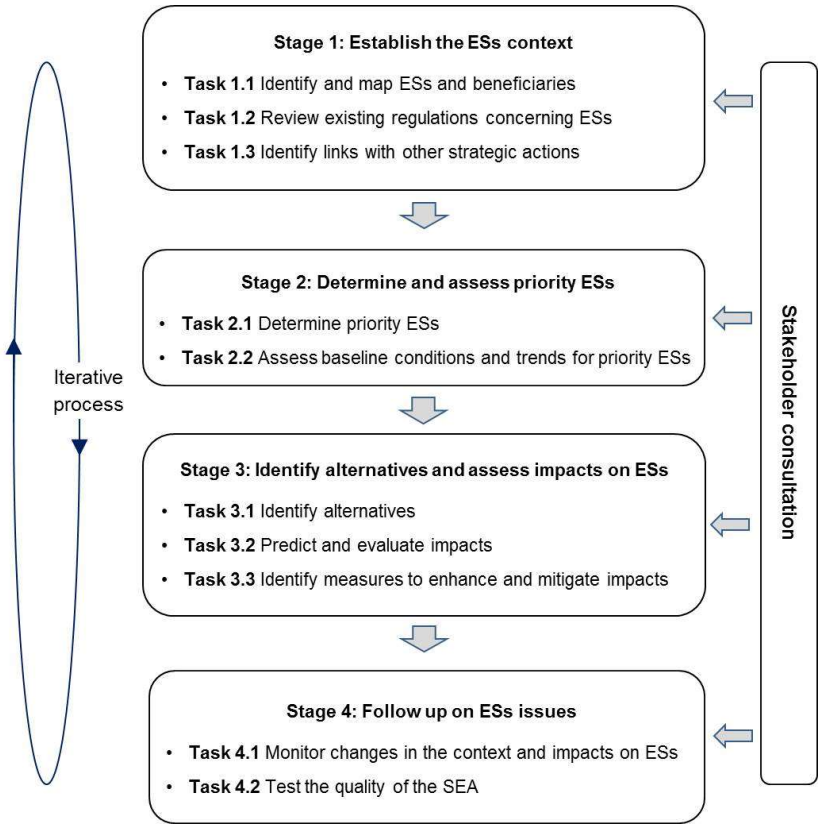

Figure 2. Stages and tasks to integrate ES in SEA. Source: modified after Geneletti (2015a)

Each successive stage in the proposed approach builds on previous work, but the sequence is not intended to be followed strictly. SEA is an iterative process, and many tasks may take place in parallel or in an order different from that presented here, according to the particular needs of the specific case, as explained in the coming sections. The overall purpose of the approach is to ensure that all relevant information of ES is collected, processed and used to support decision-making. Stakeholder consultation is a vital component of SEA, and it is relevant in all the stages, as shown by Figure 2. Timely and well-planned consultation programmes facilitate the development of a shared vision of problems and objectives, contributing to the successful design, implementation and management of plans and policies (Slootweg et al., 2006; Abaza et al., 2004).

3. Stage 1: Establish the ES context

In this first stage, SEA needs to provide an understanding of the context within which the plan will be developed and implemented. This requires identifying and mapping ES and beneficiaries for the

region that will be affected by the plan (Task 1.1), reviewing existing regulations concerning these services (Task 1.2), and identifying links with other existing or foreseen strategic actions (Task 1.3).

Task 1.1: Identify and map ES and beneficiaries

In order to incorporate information on ES into SEA, a general understanding of how ecosystem services are produced and used in the planning region needs to be achieved from the very beginning of the process. This can be obtained by: i) identifying the main ecosystem types occurring in the study area, ii) determining the services produced by these ecosystems, and iii) describing the beneficiaries of such services (disaggregated by gender and other sensitive groups, if possible) and the contribution provided to their wellbeing (e.g., in terms of health, material assets, security). Alternatively, one may start by identifying the key elements of wellbeing for the region's inhabitants, whether or not they are shaped by ES. Then, the ecosystem goods and services that matter the most for those elements should be identified, and traced back to the ecosystems that supply them.

This task requires building a conceptual framework to link socio-economic systems with ecosystems, via the flow of ES. Many frameworks have been proposed for this purpose, including the MA (2005), TEEB (TEEB, 2011), and IPBES (IPBES, 2013) frameworks, the ES cascade model (Haines-Young and Potschin, 2010) and the EU framework for ecosystem assessments (Maes et al., 2013). All these conceptual frameworks relate to one another to some extent, even though they introduce differences, for example in the description of the wellbeing components or in the definition of the relationships between ecosystems and the values provided to people. Practitioners can refer to these frameworks to identify the most suited to their specific SEA context. Figure 3 presents an example of application of the MA framework to inform the early stage of SEA for a municipal development plan. This analysis allowed to identify the main direct and indirect drivers of ecosystem change and their effects on ES and ultimately on human wellbeing.

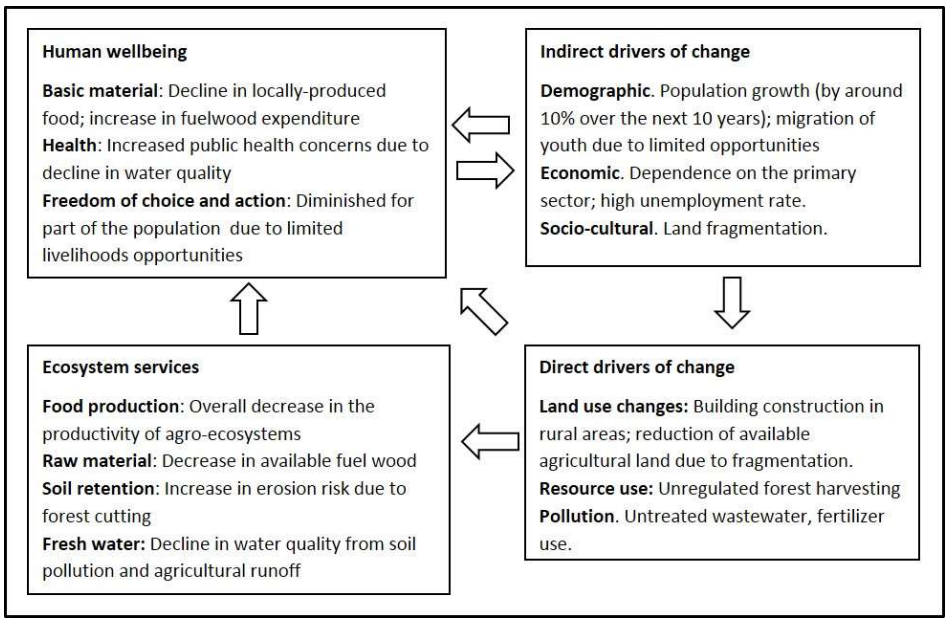

Figure 3 Analysis of the interaction between socio-economic and ecological systems in the municipality of Partesh/Partes (Kosovo) to support the SEA of the Municipal Development Plan. Source: Geneletti (2016b).

Whenever possible, details should be added concerning the relevance of ES for the wellbeing of different groups of beneficiaries, with specific attention paid to the most vulnerable groups in

terms of geographical location, as well as socio-economic conditions (e.g., by considering the level of dependence of different livelihoods on a given ES and the "substitutability" of that service). In addition, it is desirable to have also a (rough) geographical indication of where ES are produced and used.

Stakeholder consultation is essential for this task. Stakeholders' opinions can help to simplify the problem and get the essential right. For example, participatory mapping approaches can be undertaken to gain a clearer view on what matters for people's wellbeing, and how this is associated to ecosystems, and their services. Men and women often have different roles, albeit related, in the use and management of natural resources and ES. It is essential, therefore, to take these roles into consideration during the design of stakeholder consultation activities, as well as the subsequent SEA stages.

Task 1.2: Review existing regulations concerning ES

ES often have some form of legal protection. Hence, a first and obvious step is to make sure that the plan is at least compliant with existing regulations and legal obligations. Of course, policy-making should comply with legal obligations irrespective of whether a SEA is carried out or not. However, SEA makes sure that this is actually performed, so as to enhance the compatibility of plans and policies with the existing regulatory and strategic frameworks (see also next task). This task can be broken-down into three activities. Firstly, identify all the existing regulations and legal obligations that set conditions for the use or protection of ES in the region. This activity is made difficult by the fact that regulations may contain "hidden", or anyway not explicit, references to ES. For example, an Act concerning indigenous people may contain implications on how land need to be used and managed to ensure supply and fruition of ES (e.g., access to religious or cultural sites, food supplies, traditional medicines, etc.).
Examples of possible regulations to be reviewed include (modified after Slootweg et al., 2006):

- Provisioning services
    - Extractive reserves (forest, marine, fisheries);
    - Areas of high-quality soil;
    - Areas of indigenous interest;
    - Groundwater and surface water protection areas.
- Regulating services
    - Urban and regional regulations on impervious surfaces;
    - Flood storage areas;
    - Regulations on forest and pasture for preventing hazards;
    - Regulations on riversides;
    - PES (Payment for ecosystem services) schemes.
- Cultural services
    - Natural monuments, natural heritage sites and cultural heritage sites;
    - Archaeological parks;
    - Sacred sites;
    - Urban green areas.
- Supporting services
    - Nationally protected areas/habitats, protected species;
    - International status: Ramsar convention, UNESCO Man and Biosphere, World Heritage Sites;
    - Subject to national (e.g., UK Biodiversity Action Plans) or regional regulations (e.g., European Union Natura 2000 Network);

- Sites hosting species listed under the Convention on the Conservation of Migratory Species of Wild Animals of the Convention on International Trade in Endangered Species of wild Flora and Fauna;
- Sites hosting species listed under the Bern Convention.

Secondly, identify the specific ES-related content of the identified regulations, and present it in a way that can be easily communicated to policy-makers and stakeholders. This may include producing maps showing areas of concern for the specific regulation (e.g., designated sites; buffer zones of water bodies, habitat maps) or summaries of key elements (e.g., minimum requirements for green space in urban areas; no-net-loss policy on pervious surfaces; constraints on land development). Thirdly, provide initial comments (as far as it is feasible at this stage) on the implications of the regulation for the development of the plan. The latter action involves answering questions such as:

- What geographical areas/ecosystem types are addressed by the regulation?
- What stakeholders and beneficiary groups, disaggregated by gender and other sensitive groups, are mainly concerned?
- Does the regulation set constraints to decision making? How?
- Does the regulation offer opportunities for synergy with the plan? How can the plan contribute to the regulations objectives and vice versa?
- What specific elements of the plan are concerned the most by the regulation?

In conclusion, the output of this task should not be a mere listing of existing regulations: this would simply add a layer to the huge pile of information that decision makers should be aware of, with likely limited effects on the final outcome. A further step needs to be taken, by identifying key content and bringing it to the attention of decision makers in a clear and concise way, together with comments on the potential synergies and criticalities. In this way, the output can serve the purpose of both reminding decision makers of issues that need to be taken into account (in a "reactive" way), and proposing ideas and strategies (in a "proactive" way). Obviously, synergies and constraints can be more or less identifiable according to the state of advancement of the plan. For this reason, the output of this task is not intended as a static picture, but needs to be updated and revised during the SEA, and used to inform the process.

Task 1.3: Identify links with other strategic actions

This task aims at identifying other relevant strategic actions at various levels (e.g. national, regional, local), whose content must be taken into account to exploit synergies and reduce inconsistencies in terms of ES use and conservation. The task is similar to the previous one in that its purpose is to harmonize the plan with the external context. Even though the analysis is typically carried out for external actions that belong to higher or equal decision levels (e.g. for a regional strategic action: national and regional PPP), it can be worth exploring also actions on lower levels (e.g., local-level PPP), as well as individual projects. In particular, large-scale projects (e.g., a dam, a major transportation infrastructure) may influence the content and implementation of the plan.

In SEA, this task is often called "external compatibility appraisal". It can be conducted both in a reactive (i.e., by testing if the proposed plan is compatible with the external context) and proactive way (i.e., by using information on the external context to shape the content of the plan and exploit synergies). Guiding questions to identify links with other strategic actions include:

- Do the objectives of other plans or policies depend on ES that will be affected by the plan?
- Are other plans or policies likely to affect ES that are needed to achieve the objectives of the plan?
- Does the plan contribute to enhance ES that are needed by an external plans or policies, or vice versa?

This task needs to be repeated throughout the planning process. In the preliminary stages it is conducted by looking at the objectives proposed in the plan. Later on it can be performed by analyzing the specific policies and activities proposed to achieve such objectives. This reiteration is important because objectives might be too broad or too vague to allow a proper understanding of their effects on ES. Specific policies (e.g., a zoning scheme for a spatial plan) will allow unveiling of critical interactions that can be brought to the attention of the decision makers at a stage where they can still be corrected or reviewed.

4. Stage 2: Determine and assess priority ES

The output of Stage 1 is likely to include an extensive list of ES, and associated beneficiary groups. In order to improve the effectiveness of SEA, Stage 2 generates detailed information on a limited set of ES, which are considered relevant for shaping and informing the development of the plan. This requires determining priority ES (Task 2.1), and assessing their baseline conditions and trends (Task 2.2).

Task 2.1: Determine priority ES

Setting priority ES is best done in close collaboration with stakeholders and beneficiaries. In these initial stages, the content of the plan is typically in the form of a draft set of problems that the plan wishes to solve, and objectives that it wishes to achieve. By analysing this content, a preliminary screening can be performed in order to identify:

- The services upon which the plan depends;
- The services that the plan may affect (positively or negatively).

A plan depends on an ES if the service is an input or if it enables, enhances or regulates the conditions necessary for a successful outcome of the plan (OECD, 2008). For instance, a tourism development plan may depend upon cultural services (such as aesthetic value) provided by coastal ecosystems. A plan affects an ES if it triggers drivers that decrease (negative impact) or enhance (positive impact) the quantity or quality of that service. For instance, a regional development plan may promote land-use changes that negatively affect the provision of freshwater. This systematic analysis of dependences and impacts helps uncover unforeseen interactions between ES and the plan. Identifying these interactions up-front will enable decision makers to proactively manage any associated risks and opportunities (Ranganathal et al., 2008).

Guiding questions to support the identification of priority ES include (OECD, 2008; Landsberg et al., 2011):

- Is the plan likely to trigger or reinforce drivers that contribute to the degradation of the ecosystems?

- Can the plan trigger or reinforce drivers that contribute to enhancement of ES important for people's wellbeing (e.g. by improving the quality and quantity of ES supply or by enhancing the ability of people to benefit from ES)?
- Is the plan likely to limit the ability of people (within and outside the planning region) to benefit from ES?
- Is the plan likely to affect the demand for a given ES, either directly (because the plan depends on it for the achievement of its objectives) or indirectly (because it increases demand by other)?
- Is economic development and human wellbeing for different groups of people likely to be affected by a decline in the ES?
- Is the affected ES a major contributor to the wellbeing of the potentially affected groups of people?
- Does the affected ES have a cost-effective substitute?

Table 2 shows an example of analysis of dependencies and impacts to identify priority ES. Specifically, it presents the analysis of the possible relationships between some of the objectives of a hypothetical Spatial Plan for the development of a mountain region in Trinidad and Tobago and ES. For each of the three plan objectives, the first column indicates the ES required for its achievement. The matrix indicates also when such dependence may extend beyond the boundary of the area being planned, hence requiring a broader scale analysis (e.g., the regulation of water may depend upon decisions taken outside the region). The second column identifies situations where the achievement of the objective will have a positive/negative effect on the ES. For instance, the protection of natural areas is bound to contribute to soil formation and retention, but it may have both positive and negative effects on recreation opportunities. Similar analyses are useful also to test the "internal consistency" of the plan. Potential inconsistencies exist whenever the achievement of one objective relies on a given service, which can be affected by a different objective. These situations can be detected by looking at each row of the matrix (see, for instance, the case of water regulation). The results of this type of analyses can suggest, for example, revisions of the objectives, but also additional stakeholders to be consulted (i.e., beneficiaries of the services affected).

This task requires wide stakeholder consultation to obtain existing information and to confirm the values, interests and dependencies on priority ES with people who need and use them, considering also gender issues. Stakeholder engagement is crucial to understand the complex relationships between a society and its biophysical environment. An effective stakeholder consultation ensures that no relevant issues are left out, and allows to properly setting the "boundaries" of the SEA in a way to encompass the views and interests of all affected people.

A critical issue in stakeholder consultation is represented by the involvement of the poor. Biodiversity has been described as "the wealth of the poor" (WRI, 2005), but power imbalances and governance failures make the poor often invisible and not fully involved in the planning/policy making processes concerning the use of natural resources. This, together with problems such as weak land rights, weakly enforced legislation and corruption, cause the benefits of ecosystems to be captured by those far away (e.g., genetic resources exploited by international corporations) or by national government with limited local effects (e.g., wildlife tourism), to the detriment of the poor who are stewards of the ecosystems (Roe et al., 2011). This issue needs to be seriously considered in SEA, by improving participation of the less wealthy and more vulnerable groups (e.g., minorities) in the identification of priority ES (as well as in subsequent decision-making stages), in order to ensure that their interests are not overridden in favor of more powerful concerns.

Table 2. Analysis of dependencies and impacts to identify priority ES for the SEA of a spatial plan. Key: D: Dependence; I: Impact; (+)+: (Very) Positive impact; (-)-: (Very) Negative impact; ●: Dependence between objective and ES; : ○: Dependence that extends beyond the planning region. Note: The matrix has been adapted from the one produced by the participants of the workshop "Integrating ecosystem services in Strategic Environmental Assessment for policy support", held in Port of Spain on December 3-5 2014. All elements of this matrix are purely hypothetical and intended for illustrative purposes only. Source: Geneletti (2016b).

	To protect watersheds		To ensure suitable development of quarrying, housing, transportation and agriculture activities								To develop a non-invasive eco-tourism industry	
			Quarrying		Housing		Transport		Agriculture			
	D	**I**	**D**	**I**	**D**	**I**	**D**	**I**	**D**	**I**	**D**	**I**
Soil conservation	●	++		--		-		-	○	+/-		-
Water regulation	●	++		-	●	--			●	--	●	
Hunting		+		-		-		-		-		
Water purification		++		--	●	-				--		
Carbon sequestration		++		-		--						
Recreation		+/-		-				+/-		+	○	++
Aesthetic appreciation		+/-		-	●					+	○	+/-
Food and medicine		-/+		-		-		+		++		

Task 2.2: Assess baseline conditions and trends for priority ES

In this task, a detailed analysis of the current state of priority ES, as well as their likely evolution without the plan, is carried out. The output should provide as clear a picture as possible about:

- Current distribution of priority ES, and benefits provided to different groups of people;
- Key direct and indirect driving forces;
- Likely future trends, threats and opportunities.

Assessing baseline conditions for ES can be challenging or overly time consuming. However, one must remember that baseline data in SEA essentially serve three purposes (adapted from Therivel , 2004): i) identifying critical issues and opportunities related to ES to ensure that they can be addressed by the plan; ii) describing current conditions and expected trends so as to have a reference against which measuring the performance of the plan; and iii) providing a basis for the prediction and assessment of the impact on ES. These purposes should be kept in mind when deciding when to stop collecting and processing baseline data, and move on. A complete baseline is not necessarily needed to proceed with the SEA, and additional data should be collected only if they provide a relevant contribution to one of the purposes above.

The assessment of ES can be conducted in qualitative or quantitative way. Quantitative assessments, in turn, can be based on monetary or non-monetary (e.g., biophysical) measures. The complementarity of different assessment approaches should be acknowledged in SEA practice. Monetary valuation offers many advantages, but it may not be always appropriate or even possible (TEEB, 2013). The assessment of ES in their own term may be more meaningful for stakeholders than a monetary value (e.g., the recreational or spiritual value of a landscape feature). Hence, different types of assessment can be chosen for the different ES. The objective and scope of the SEA (including the foreseen interactions with stakeholders along the process), as well as the availability of data, time and resources, will play a key role in selecting the appropriate way to assess ES, as well as the specific methods.

It is fundamental for this task to include a dynamic component, by providing information not only about the current conditions, but also (and especially) about possible future trends. This will provide the basis for developing the plan in a way that it can adequately "fit" these trends (e.g., by reducing risks and exploiting opportunities related to ES). It will also provide the basis for assessing the impact of the plan against the baseline conditions (see Stage 3). Analyzing trends in ES requires the identification of key drivers that are influencing them. Drivers can be of a direct nature (e.g., physical interventions, such land use changes) or an indirect one (policies that may affect the way in which society makes use of ES, such as for instance the ones that regulate accessibility to recreation areas). Operational guidance on the analyses of drivers and trends can be found in UNEP (2009) and Ash et al. (2010).

5. Stage 3: Identify alternatives and assess impacts on ES

In this stage, the plan is taking shape and specific alternatives are proposed. SEA has the purpose of contributing to the identification of possible alternatives to enhance ES, or at least minimize negative effects on them (Task 3.1), predicting and evaluating impacts for each alternative (Task 3.2), and identifying measures to enhance and mitigate impacts (Task 3.3).

Task 3.1: Identify alternatives

This task has the purpose of contributing to the identification of possible courses of action to enhance (priority) ES, or at least minimize negative effects on them. The analyses conducted in the previous two stages and the information collected so far (including stakeholders' perceptions and values) is used to ensure that key ES-related issues are mainstreamed in the actual content of the plan. Alternatives can be generated as a reaction to proposals formulated by planners/policy makers (e.g., proposing infill development as opposite to urban expansion in areas that provide important water regulation services), or as a response to issues that emerged during the previous stages, and that need to be adequately addressed by the plan (e.g., proposing a constraint to land-use conversion in an area that proved to be essential in providing a priority ES). Alternatives developed during the SEA can be radically different ways to achieve a given objective, or can result from adjusting and fine-tuning existing proposals (e.g., by suggesting better implementation details or location for a given activity).

Ideally, the proposed alternatives should contribute to:

- Promoting synergy (or at least avoiding conflict) with existing regulations, plans and policies relevant for ES;
- Minimizing the dependency of the plan on priority ES;
- Enhancing positive (and minimizing negative) effects on priority ES;
- Having desirable effects on drivers of ES change;

- Generating a more equitable distribution of cost and benefits, particularly considering vulnerable stakeholders

Figure 4 provides an example of alternatives developed to enhance ES. A study conducted in Chiapas (Mexico) investigated possible forest management options in a degraded and fragmented landscape, by considering criteria related to forest biodiversity and regeneration potential, but also to key regulating services (e.g., soil retention) and provisioning services (access to timber and fuelwood, subsistence animal production and cropping). The f~~F~~igure ~~4 (left)~~ Illustrates the conceptual approach followed for the development of forest management options, which consider also access to priority ES by villages' inhabitants. The study provided information on the opportunity cost of different management options, and its outcome can be used as a basis for developing restoration plans and policies. ~~Figure 4 (right) shows one of the proposed forest management options (extends 1, 2 and 3 enlarge the area around the main villages)~~.

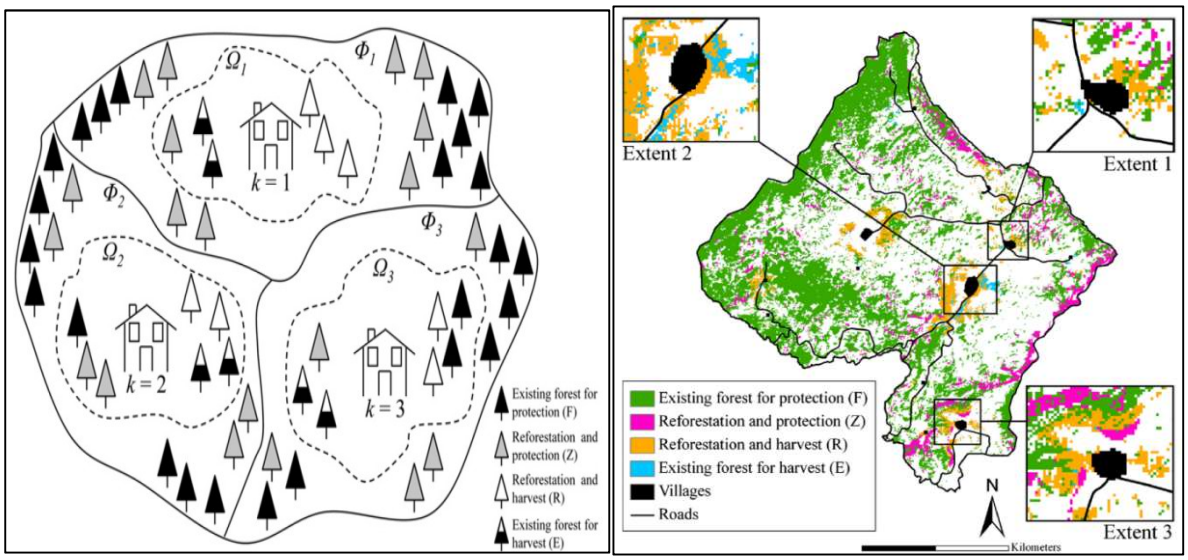

Figure 4. Example of alternatives developed to enhance ecosystem services ~~(see text)~~. Source: Orsi et al (2011).

Task 3.2: Predict and evaluate impacts

This task has the purpose of providing information on which ES would benefit or be worse off, and which groups of people would win or lose, if a given alternative is selected. This information will provide the basis for discussions with stakeholders and planning/policy makers and for supporting the final decision-making process (which typically requires knowledge also on additional issues besides ES). The identified alternatives are compared in terms of their impact on ecosystem services, in order to suggest the options that enhance opportunities (e.g., for conservation of ES, improvement of quality/quantity of ecosystem service provision, increase in potential beneficiaries) and reduce risks (related, for example, to high level of dependence on ES, degradation, conflict in access and use).

Impacts are defined as the difference between the conditions of a given variable with and without the plan through time. Hence, impacts can be desirable (positive) or undesirable (negative) changes that result from the implementation of the plan. Impact assessment should inform about the consequences of the alternatives under consideration on the provision of a given service (e.g., change in quality/quantity of yield of crop; change in denitrification capability within a watershed;

change in the area of landscape in attractive condition). It should also inform about the importance of such changes for beneficiaries, by considering issues such as dependency and replaceability, poverty, vulnerability, access, etc. (see Landsberg et al., 2013). Hence, the overall significance of an impact is a function of both the magnitude of the change, and the importance of that change for the wellbeing of the affected people (Figure 5).

Performing impact assessment requires knowledge of the relationship between ecosystems, ES and human wellbeing, which was gained in the previous stages. In particular, the baseline and trends analysis provides the reference against which the performance of different alternatives can be measured (including the "do-nothing" alternative, if meaningful), and the basis for suggesting the alternative(s) that better fit the desirable future conditions that the plan is pursuing (Geneletti, 2013b).

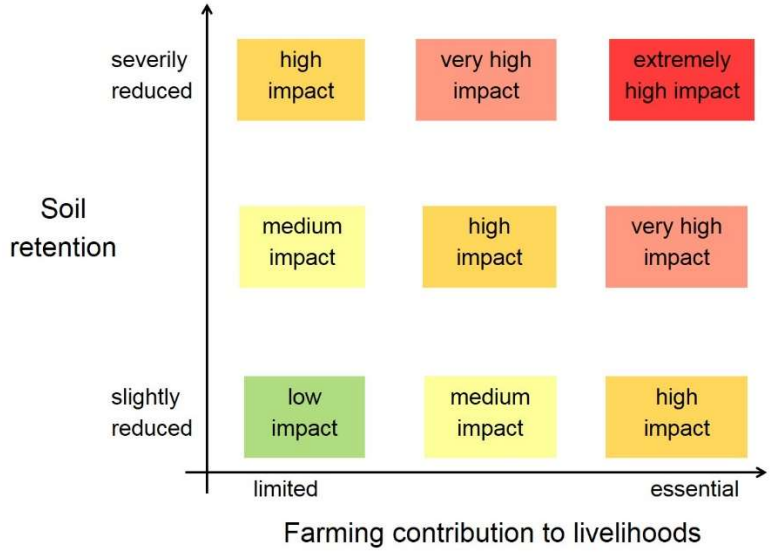

Figure 5. Conceptual diagram to assess the significance of ES impact. The impact significance is estimated by combining the expected magnitude of change in the capability of ecosystems to prevent erosion (y-axis: soil retention), and the importance of well-preserved soil to the livelihoods of local villages (x-axis: contribution of farming to livelihoods). The highest impacts correspond to severe reductions in soil retention in areas where people rely on subsistence farming. Source: Geneletti (2016b).

Several methods and techniques for impact assessment can be used, according to the level of detail of the analysis and the way in which ES have been characterised in the baseline (e.g. models and quantitative analysis, expert opinion and qualitative descriptions, monetary evaluation, assessment of ES in their own terms, etc. See examples in Burkhard et al., 2013). Generally, in SEA qualitative impact, prediction and evaluation are more common than quantitative ones, due to the inherently high uncertainty levels (in the data, in the future trends of key drivers, etc.), the complexity of the decisions and the time and resources constraints of the planning/policy-making exercise (Jones et al., 2005). However, examples of more quantitative approaches for ecological impact assessment in SEA exist (e.g. Noble, 2008). Even though issues addressed by SEA are in general less tangible than those addressed at the project level, there is a lot of room to improve the analytical content of SEA, as argued by Geneletti (2015b). This applies particularly to plans and programmes that provide detailed regulations, such as for example the zoning scheme of an urban plan that identifies permitted/prohibited land-use changes in each land unit.

Whenever possible, spatially-explicit impact assessment methods should be preferred because they offer a better understanding of the complex relationships between areas of ES production and use, and they may help to differentiate impacts by beneficiary groups (e.g., mountain versus lowland villages; wealthy versus disadvantaged neighbourhoods; different municipalities within a region). Spatial approaches are in general computationally more complex and need more data. However, most baseline data related to ES are typically available in map format, and new software tools are being developed that use relatively simple models with few input requirements (Kareiva et al., 2011). Qualitative spatial approaches (e.g., participatory mapping) can be particularly useful to engage stakeholders and communicate results.

Many problems related to the loss or degradation of ES result from the cumulative effects of human activities. Cumulative effects are the net impact from a number of different activities and can occur from the following situations (Cooper, 2004):

- Interaction of impacts from proposals and policies within a plan affecting the same ES. For example, proposals to build infrastructures, commercial premises and housing within a short period of time could result in cumulative loss of open space and attractive landscape for recreation. Analogously, a policy to encourage renewable biofuels cultivation and a land consolidation policy could result in a cumulative loss of subsistence cropping;
- Combined impacts of the strategic action with impacts of other actions affecting the same ES in a particular area. For example, proposals from urban and forest plans could interact and affect the regulation of local climate.

One of the main *raison d'être* of SEA is the assessment of cumulative effects, given that individual impacts from a single project or development may not be significant on their own, but become significant in combination with other impacts. Hence, SEA cannot be limited to the analysis of individual elements of the plan, but needs to also carry out an overall assessment of the future conditions of priority ES, in the light of all the activities and policies that the plan includes. Additionally, other past, present and reasonably foreseeable future actions within space and time boundaries that could contribute to cumulative effects on a given ES should be considered (Canter and Ross, 2010). Cumulative effects can also be positive. For example economic incentives for planting hedgerows and trees in rural areas and policies to promote river banks restoration could cumulatively result in better nutrient retention and water filtration.

Task 3.3: Identify measures to enhance and mitigate impacts

This task aims at suggesting how to enhance positive impacts and opportunities connected to the implementation of the plan, and mitigate negative impacts and risks. Enhancement and mitigation measures may include changes to the plan (e.g., removal/addition/refinement of elements, such as policies or regulations), as well as guidelines for later decisions. The latter comprise, for example, recommendations for institutional adaptation or new regulations that should be taken on board in subsequent policies or plans and recommendations for project's EIA (e.g., ToR for future EIA of projects affecting a specific area or ES) (Partidario, 2012).

Following the revised mitigation hierarchy proposed by Bond et al. (2013), the SEA should seek measures that, in order of priority: Enhance ES; Avoid negative effects on ES; Reduce negative effects; Repair negative effects; Off-set negative effects. Figure 6 illustrates this concept and provides some useful guiding questions to identify measures to enhance and mitigate impacts.

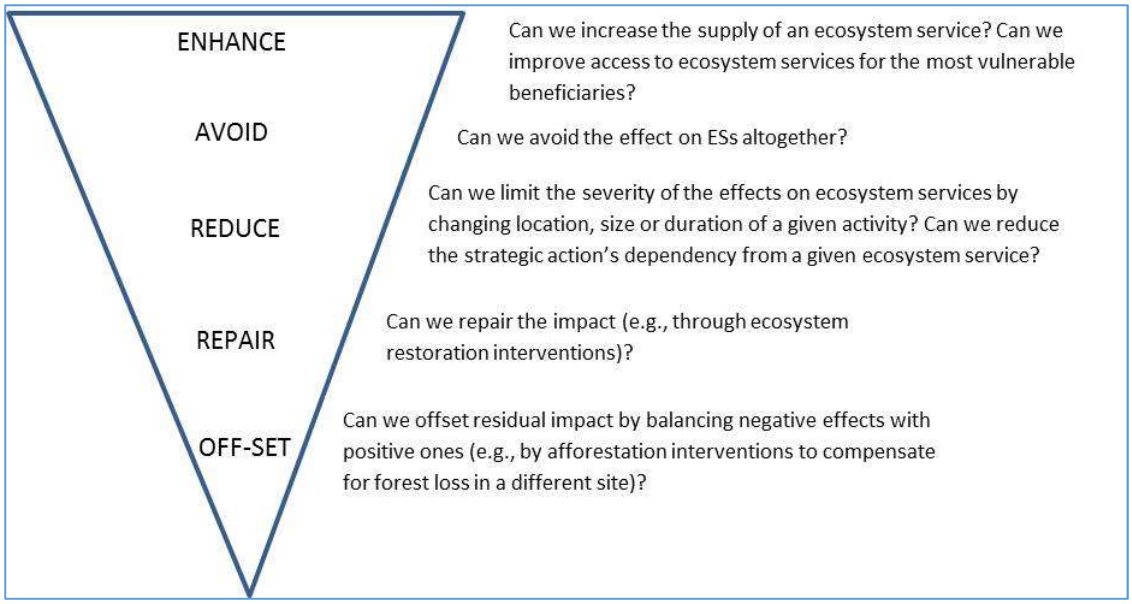

Figure 6. The "mitigation hierarchy" and examples of guiding questions to identify measures for enhancement and mitigation of the plan effects on ES.

6. Stage 4: Follow up on ES

This stage begins when the plan has been approved and aims at understanding the effective progress in its implementation, the actual impacts on ES, as well as relevant contextual changes. It entails two tasks: monitoring and managing ES during implementation and testing the quality of the SEA process.

Task 4.1: Monitor changes in the context and impacts on ES

Follow-up is defined as the monitoring and evaluation of the impacts of the plan for management of, and communication about, its environmental performance (Morrison-Saunders and Arts, 2004). Follow-up ensures continuity to the SEA process, and allows detecting contextual changes that may occur during the implementation of the plan, along with progress in its effective implementation and actual impacts (Partidario, 2012).

This task has two main objectives: i) monitoring changes in the ES context; ii) monitoring the actual impacts of the plan on ES. Concerning the first objective, insights need to be gained into the environmental and socio-economic changes that occur in the area during the implementation of the plan, and that may affect the supply, demand or use of ES. Relevant changes that have direct or indirect effects on ES can be related to the state of the environment (e.g., climate trends, natural disasters), the social profile (e.g., migration patterns), the socio-economic situation (e.g., shift in livelihood systems), and the legislative and regulatory framework (e.g., designation of protected new areas; land reform policy). Existing monitoring and reporting programmes (e.g., state of the environment reports) represent a useful starting point for this activity. Early detection of relevant contextual changes enables adjustments to the plan, thus ensuring the continuing facilitating role of SEA (Partidario, 2012). This task is also instrumental to filling the gap in knowledge (e.g., on the quantification of ES) that arose during the SEA, but could not be addressed for lack of time or resources.

The following are examples of guiding questions that can be used to periodically monitor the context and detect changes that need to be brought to the attention of the people in charge of implementing or revising the plan:

- Have new formal regulations linked to ES been approved in the study region (e.g., designated areas, PES schemes)?
- Have other policies, plans or projects been approved or implemented that could affect the supply, demand or use of ESs (e.g., energy policy, agricultural reform, urban plan)?
- Has the demand for a particular priority ES by stakeholders changed (e.g., due to droughts, change in trade policy, change in access to specific locations)?
- Has the supply of a particular priority ES changed (e.g., following a natural disaster)?
- Is there new evidence available concerning ES (e.g., ecosystem maps, economic valuations, surveys on users' needs?
- Does this new evidence or knowledge suggest changes in the analysis carried out during the SEA (e.g., assessment of baseline conditions and future trends, impact prediction), hence in the final recommendations?

With respect to the second objective, evidence needs to be collected about the actual impacts of the plan on ES, in order to evaluate to what extent the observed impacts differ from the predictions performed during the previous stages. The ultimate purpose is to enable timely intervention and correction of detected problems (e.g., unforeseen impacts, mitigation and enhancement measures not carried out). Important elements of an efficient monitoring system include (Morrison-Saunders and Arts, 2004):

- Identification of indicators and description of the methods, frequency and responsibility for data collection (responsibility may vary according to the nature of the indicators);
- Guidance on data evaluation (appraisal of the conformity with predictions or expectations);
- Guidance on management (how to take appropriate response to issues arising from evaluation);
- Communication strategies (informing stakeholders about the results or, where appropriate, involving stakeholders in the evaluation and/or management stages).

The selected indicators should be consistent with the ones used to inform the previous SEA analyses (e.g., indicators used in Task 2.2), limited in number (to ensure viability of the monitoring system), and possibly easy to measure, interpret and communicate. Besides contributing to a better implementation of the plan under consideration, this task has an important learning objective for future SEA: it helps understanding what went wrong with impact prediction and how to make better predictions, hence improving the practice of mainstreaming ES into SEA and decision-making.

Task 4.2: Test the quality of the SEA

This task aims at checking if the SEA process has been carried out well, with respect to consideration of ES. Being the process that matters, and not so much the content of the final report, it is recommended to perform this analysis throughout the SEA, rather than only at the end of it. In this way, shortcomings and limitations can be highlighted, and integration proposed when they can materially be used to improve the plan. The lessons learned from quality control checks are also beneficial for future applications and can improve the practice of integrating ES into SEA. This is currently a very important issue, given the lack of experiences and case studies in this field (Rosa and Sánchez, 2015).

The following guiding questions can be used to check Influence of ES information on the planning process and content:

- Was the information on ES provided by the SEA process adequate and useful from the point of view of both decision makers and stakeholders?
- Has there been effective cooperation on ES issues between the SEA team and those responsible for developing the plan?
- Was there effective stakeholder involvement on issues relevant to ES?
- Did the SEA lead to measures and outcomes that better reflect ES in the planning/policy-making process?
- Did the SEA succeed in integrating into the plan operational measures (e.g., budget allocation) for dealing with risks of depleting ES?
- What were the main strengths and weaknesses of the SEA process (in terms of availability of data on ES, analysis of ES relevance, stakeholder involvement, etc.)?
- Did the SEA improve the capacities of decision makers and stakeholders to manage ES?
- Did the SEA enhance the transparency and accountability of the planning decisions related to ES?
- Did the plan contribute to verifiable progress on ES protection/enhancement?

Finally, the following guiding questions can be used to check the extent to which the SEA content reflected knowledge of ES:

- Did the SEA identify priority issues for ES, rather than all potentially significant issues?
- Have the substantial objectives related to ES conservation/enhancement been identified and described?
- Did the SEA identify and describe any conflicts that exist between these objectives and the plan?
- Did the SEA take into account alternative options, based on the way these alternatives affect ES?
- Did the SEA provide useful information on ES -related risks/opportunities related to the plan, and on mitigation measures/adaptive strategies that could be adopted?
- Were the impacts, and the methodologies for assessing impacts, on ES clearly described?

7. Conclusion

This chapter provided guidance to include in SEA analyses that can clarify the potential impacts of planning decisions on ES, in order to avoid unintended negative consequences, and seize opportunities for improvement. The proposed analyses can be used in different contexts and for different types of SEA processes. The integration of ES in SEA has various benefits in terms of contributing to better design of policies and plans, but there are also critical issues that need to be recognized. These include the complexity of appropriately evaluating ES, and the lack of well-established indicators and assessing methods. These issues can be addressed by learning from the pilot applications and case studies that are being carried out around the world, as well as by taking stock of the data, tools, and methods for ES analysis that are becoming increasingly available in the scientific (and grey) literature (Guerry, 2015). Practitioners are faced with the challenge of

including ES and showing their added value to decision-making, within the time and resource constraints of real-life planning and policy-making processes.

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