17th International Conference on Environmental Science and Technology

Athens, Greece, 1 to 4 September 2021

Integrating Ecosystem Services (E.S.) in spatial planning: a literature review

POZOUKIDOU G, PAPAGEORGIOU M. and KESISOGLOU D.*

Aristotle University of Thessaloniki, School of Engineering, Department of Planning and Development, University Campus, 54124 Thessaloniki, Greece

*corresponding author:
e-mail: doukenik@plandevel.auth.gr

Abstract: Integration of ES in spatial planning constitutes a critical issue in the context of establishing resilient and sustainable policies. In this paper, a literature review was performed, to evaluate the integration of ES in spatial planning practices through institutional and governmental planning documents. The results indicated that ES have been gradually capturing the interest of the planning scientific community. However, the number of publications concerned with this topic is still very limited and with no clear methodology on the issue of integrating the ES concept in spatial planning. This paper suggests that the integration methodology to be built should focus more on urban environments, and with the intention to achieve integration within areas defined by ecosystem boundaries rather than administrative ones.

Keywords: Ecosystem Services, Spatial Planning, Review

1. Introduction: Ecosystem Services and Spatial Planning

Ecosystems are fundamental sources of prosperity, vital to human well-being, due to the production of goods and life support functions (Daily, 1997; Schröter et al., 2019). In recent bibliography the "ecosystem" term was first used by Tansley in 1935, and then established (in late 1960s, early 1970s) in the biological science/field (Daily, 1997). Ecosystem Services (ES) on the other hand, as a term, was introduced in the 1980s. The concept of ES however, gained momentum two decades later (Schröter et al., 2019), after the publication of the MEA report (Millennium Ecosystem Assessment, 2005), and especially after the publication of the international TEEB initiative (The Economics of Ecosystems and Biodiversity, 2010), aiming at mainstreaming the values of biodiversity and ES into decision-making and emphasizing at a political level, the rising costs of biodiversity loss and ecosystem degradation (Grunewald and Bastian, 2015; Schröter *et al.*, 2019).

According to MEA (2005), ES are defined as '*benefits that people obtain from ecosystems*', whilst according to TEEB (2010) as '*direct and indirect contributions from ecosystems to human well-being*'. According to MEA (2005), Ecosystem Services (ES) fall into the following four categories:

- ✓ provisioning services: food (including seafood), raw materials, genetic resources, medicinal resources, energy, etc.
- ✓ regulating services: purification of water and air, climate regulation, carbon sequestration, flood protection, waste decomposition, disturbance regulation, etc.
- ✓ cultural services: spiritual and historical, recreational experiences, science and education, therapeutic services, etc.
- ✓ supporting services: nutrient cycling, primary production, soil formation, habitat provision, etc.

The concept of ES is known for having a unifying and interdisciplinary character, connecting environmental and socio-economic aspects (Grunewald and Bastian, 2015). In addition, the ES concept is known for including economic and socio-cultural values, to be taken into consideration in the decision-making process, policy making, impact assessments and spatial planning (Gómez-Baggethun and Barton, 2013; Schröter et al., 2019). To this end, Common International Classification of Ecosystem Services (CICES) was designed to help measure, account for, and assess ecosystem services and has been widely used in ecosystem services research to design indicators, for mapping, and for valuation (Haines-Young et al. 2018).

Information and data on the ESs, is of vital importance to decision-makers, supporting them to establish resilient and sustainable spatial planning policies, as well as to evaluate the impacts of planning and spatial strategies on landscapes' (and seascapes') and on their ability to keep providing goods and services. When ESs are neglected in decision-making (and by association in spatial planning), productive and multifunctional landscapes become degraded, multi-functionality and biodiversity is lost, resulting in greater economic losses (De Groot et al., 2009). Therefore it is key that the ES concept is fully and veritably integrated into the planning process (Albert et

al., 2014; Shapiro et al., 2015) and especially into institutional and governmental planning documents and specifications (Albert et al., 2014; Daily et al., 2009). So far, integration of ES into spatial planning is mainly addressed through special studies (supporting the planning process), such as the EIAs (Environmental Impact Assessments) as well as the SEAs (Strategic Environmental Assessments) (Honrado et al., 2013; Mascarenhas et al., 2015).

This article aims at performing a literature review, focusing on papers dealing with the integration of the ES concept into spatial planning practices at an international level. Following the introduction, the next sections present the methodological steps and criteria used in this literature review, followed by the results and findings of this research. The article ends with critical conclusions, evaluating the existing literature and pinpointing the future research directions on the formation of a methodology to integrate ES into spatial planning.

2. Research method and findings

2.1. Methodology of the research

The literature review performed in this article took place in March 2021. For this review, the Google Scholar web search-engine was used. The keywords introduced in the search engine and were used in pairs or in combination fell into two categories:

- ✓ Core/Main keywords strictly related to the research topic: 'ecosystem services', 'spatial planning', 'integration' and 'inclusion',
- ✓ Keywords related to planning scales: 'urban planning', 'regional planning', 'town planning', 'city planning', 'local scale' and 'regional scale'.

For each pair or in combination result, the authors recorded only English written papers appearing in the first ten pages of Google Scholar, since after that page, results presented very low correlation to the topic in question.

Papers presenting studies of EIAs (Environmental Impact Assessments) as well as studies related to SEAs (Strategic Environmental Assessments), were not included in the final list of papers, despite their key role in ensuring integration of ES into spatial planning, spatial policies and decision making processes (Honrado et al., 2013; Mascarenhas et al., 2015). In addition, documents dealing with the application of tools and methods to support spatial planning were excluded.

Based on the above set of research choices the final list of papers was compiled and a two-step analysis was performed:

1st STEP: analysis of the existing literature (published papers)

In this step, the analysis placed emphasis on the following components/variables:

- Year of publication: this information was critical to identify variations in time distribution, intensity and sequence of published papers.
- Number/Quantity of documents examined per paper: this information was important to record the volume of documents used (by each paper) to perform the tasks of analysis and/or assessment.
- Type of documents analyzed/assessed per paper: this information was essential to identify possible predilection for certain types of documents. Documents examined per paper were categorized according to the following types: Spatial Plans (of all scales); Policy documents; Specifications; Environmental Studies, etc.
- Method of Analysis/Evaluation: this information was related to the method(s) used to perform the task of analysis or evaluation of the integration of ES into spatial planning by the case studies. Initially two major categories were introduced based on the nature of method used: the qualitative and quantitative. Afterwards a more detail classification of the individual methods used was attempted based on the detail classification of tools and methods elaborated to extract, group and evaluate the results. These includes several grading and scaling systems, indicator development and coding techniques.
- Tools of Analysis/Evaluation: aiming at further specifying the method of analysis, documents were also examined in terms of tools used. Tools were categorized in three types: "content analysis", "statistical analysis" and "analysis using stakeholder and expert groups" (interviews, workshops etc.).

2nd STEP: analysis of the documents examined in the existing papers

In this step the analysis criteria placed emphasis on the spatial aspect the documents used, namely: spatial scale and geographical and functional scope:

- Spatial scale: this criterion was useful to further interpret the regulatory and/or strategic nature of the documents examined. Three scale categories were used to classify documents: national, regional (inter-regional and sub-regional) and local scale.
- Geographical and Functional Scope: this criterion was essential to evaluate the documents in terms of dealing with space delimitated under a more ecosystem-based approach or a more administrative-based approach. Documents were classified according to the following categories (and sub-categories) of space delimitation:
  - Based on soft -ecosystem- boundaries: coastal zones/areas (including marine and terrestrial parts), natural -green and blue - areas (Green Infrastructure, Protected Areas, marine areas) river basins, mountainous areas, cultural and natural landscapes, rural landscapes, urban landscapes, FUAs.
  - Based on hard - administrative - boundaries: Municipalities, Metropolitan Areas, Regions, States
  - Spatial Functions: this information was important to further evaluate the intensity of human

intervention, in the type of space that documents were dealing with. Three categories were created to classify documents: urban settings, rural and/or natural settings (green and blue), mixed settings (urban and rural space).

2.2. Results

The application of different sets and combinations of key words described in the methodology section determined a set of 27 papers, hereafter the "case studies", that were used to perform the analysis.

The classification of the case studies according to the year of publication starting from 2013 till 2021, indicated a gradual increase in the number of publications per year. In specific 78% of the case studies were published after 2017 while the peak in publications denoted in 2019 with 30% of papers to be published in this year. The increase in the volume of publications per year can be attributed to the two influential documents, this of MEA in 2005 and TEEB in 2010, that solidly established the contribution of ecosystems to human well-being and the built environment.

The number and type of documents used by each case study varied substantially. It is worth mentioning that 2 out of the of 27 case studies did not used any type of document to perform the evaluation, but rather conducted research based on stakeholder engagement methods. For the cases that the research method was document-based a wide range of number of documents were used (from 1 to 231) while the mean number of documents used for the sample of cases studies was 34.

It is interesting to examine the type of documents used to perform the review process. As expected, Spatial Plans with 48.7% is the prevalent type of document used, followed by Policy Documents with a percentage of 25.6%. The rest of the documents were Planning Specifications by 8%, Spatial Plans for Protected Areas by 5.1%, and Online Information by 2.6%. There was a number of documents (7.4%) that did not fall in any of the above-mentioned categories that were eventually consolidated in separate category. Finally, most of the case studies used only one type of document (59.2%) while a 33.3% used a variety of documents to perform the analysis and evaluation process.

The methods of analysis and evaluation are distinguished between two main approaches the qualitative and quantitative. Most of the cases (77%) appear to use a combination of the two methods ensuring a more comprehensive analysis and the perspective to draw safer conclusions. In specific almost 50% of the cases used content analysis to determine the presence of certain words, themes or concepts related to ES, followed by the quantification and analysis of these attributes. Another 27.1% of the case studies used some type of statistical method to perform a more sophisticated quantitative analysis.

The "non quantitative" approach was the preferred approach by 25% of the case studies, including interviews (16.7%), workshops (4.2%), questionaries (2.1%), and public consultation (2.1%). With the exception of the cases that employed the method of public consultation the rest of them involved mainly experts or professionals in the field of spatial planning.

Regardless of the approach used there were certain methods to extract, group and evaluate the results. A considerable amount of case studies (80%) used some type of keywords to perform the analysis. In particular, the four ES categories introduced by MEA were utilized considerably (33.3%) as keywords to extract information while the classification of ES as introduced by the CICES system was used by the 22.2% of the case studies. Other ES classification systems recorded include the UK National Ecosystem Assessment and the TEEB, but with no statistical significance.

Several techniques were used to evaluate and rank the results. Most common would be the various types of grading scales (0-5, 1-3 etc) introduced by 29.6% of case studies. Other techniques, used by the 18.5% of the case studies, include some type of coding and categorization of the answers and results or the development of certain indicators. Finally, there were techniques that were recorded only once like the SWOT analysis and prioritization ranking.

The next set of variables, which constitutes the second step of the methodology, focused on the spatial nature and scope of the documents included in the case studies. The variety of spatial scales of the documents reviewed in the case studies indicate the diverse role of ecosystem services in spatial planning. This is depicted in the significant proportion of the plans that concern urban (local) scale (29.4%), signifying a turn in the way planning community perceives the benefits of ecosystem services in the urban environments. In a more macroscopic scale where the contribution of ES is focused more on the protection of biodiversity and stability of natural ecosystems the Regional Scale as well as National Scale documents present the percentages of 40% and 20.6% respectively, while the Supranational scale has a percentage of 8.8%.

The variable "Geographical and Functional Scope" concerns the functional delimitation and determination of the documents. The 20.7% of the case studies included documents that were related to all types of space these being a combination of urban, metropolitan, coastal, rural etc. However, looking at the individual space categories the "Urban" and "Suburban" class seem to acquire the highest proportion (31%), followed by "Metropolitan" and "Urban" classes with the percentages of 17.2% and 13.8% respectively, indicating once more the rising interest in integrating ES into more urbanized and manmade environments. Marine and coastal areas were accounted with lower but still the countable percentage of 6.9% each. Finally, "Rural" areas were not high in the ranking and there was only one case (3.4%) that included this typology of space.

3. Conclusions

Undoubtably ecosystems and their services are vital for the livability and prosperity of both natural and manmade environment. Lately the concept of ES has become known for having a unifying and interdisciplinary character, connecting environmental and socio-economic

aspects, in the decision-making process, policy making, impact assessments and spatial planning. Hence, the need for integrating ES in spatial planning practices through institutional and governmental planning documents and specifications has become a critical issue.

The systematic literature review performed in the context of this research indicated some interesting results. In general ES have been gradually capturing the interest of the planning scientific community since the publication of the influential documents of MEA in 2005 and TEEB in 2010. The establishment of the nature of services and therefore benefits, that ecosystems could offer, was critical to the clarification of how ES could or should be integrated into spatial planning policies and plans. However, the limited number of publications that were concerned with the issue of integration of ES into spatial planning policies and plans, indicated that there is still a lot of space for improvement.

This assertion can be verified by the scale of spatial plans or policy documents included in the publications that were focused more on the regional level. This in turn emphasizes the strong perception about the connection of ES to the protection of biodiversity and stability of natural ecosystem rather that the benefits that ecosystem services can bring to the urban environments. Nevertheless, this perception is gradually changing since spatial plans that are less strategic and more regulating of the urban and suburban environments are gaining ground.

As far as the tools and methods used to evaluate the integration of ES into spatial plans and policies, it is quite safe to presume that there isn't a solid methodology established yet. In most cases qualitative and quantitative methods, solely or in combination, are used. The interesting element is that a lot of the evaluations performed are based on the MEA, CICES or TEBB classification, which in a way systematize the evaluation process. This could potentially be the basis for a more concrete methodology that could be replicable in various spatial scales and planning documents.

Finally, another issue that could function as a bottleneck in the integration of ES in spatial plans is the discrepancy and incompatibility between the administrative boundaries that spatial plans apply and the ecosystem boundaries that ES take place. This issue is mentioned in some case studies but not addressed in any of them, however it is worth recording it as we advance towards the establishment of a more concrete methodology.

References

Albert, C., Aronson, J., Furst, C., Opdam, P., (2014). Integrating ecosystem services in landscape planning: requirements, approaches, and impacts. *Landscape Ecology*, **29**, 1277–1285.

Daily, G.C., (1997). Nature's services: societal dependence on natural ecosystems. Island Press, Washington, D.C.

Daily, G.C., Polasky, S., Goldstein, J., Kareiva, P.M., Mooney, H.A., Pejchar, L., Ricketts, T.H., Salzman, J., Shallenberger, R., (2009). Ecosystem Services in Decision Making: Time to Deliver. *Frontiers in Ecology and the Environment*, **7**, 21–28.

De Groot, R.S., Alkemade, R., Braat, L., Hein, L., Willemen, L., (2009). Challenges in integrating the concept of ecosystem services and values in landscape planning, management and decision making. *Ecological Complexity*, **7**, 260–272.

Gómez-Baggethun, E., Barton, D.N., (2013). Classifying and valuing ecosystem services for urban planning. *Ecological Economics*, **83**, 235–245.

Grunewald, K., Bastian, O., (2015). Ecosystem Services – Concept, Methods and Case Studies. Springer, Berlin.

Haines-Young R, Potschin MB (2018). Common International Classification of Ecosystem Services (CICES) V5.1 and guidance on the application of the revised structure. Fabis Consulting Ltd.,Nottingham

Honrado, J.P., Vieira, C., Soares, C., Monteiro, M.B., Marcos, B., Pereira, H.M., Partidário, M.R., (2013). Can we infer about ecosystem services from EIA and SEA practice? A framework for analysis and examples from Portugal. *Environmental Impact Assessment Review*, **40**, 14–24.

Mascarenhas, A., Ramos, T.B., Haase, D., Santos, R., (2015). Ecosystem services in spatial planning and strategic environmental assessment—A European and Portuguese profile. *Land Use Policy*, **48**, 158–169.

Millennium Ecosystem Assessment, (2005). Ecosystems and human well-being : synthesis. Island Press, Washington, DC.

Schröter, M., Bonn, A., Klotz, S., Seppelt, R., Baessler, C., (2019). Atlas of Ecosystem Services: Drivers, Risks, and Societal Responses. Springer, Switzerland.

Shapiro, C., Arthaud, G., Casey, F., Hogan, D., (2015). Ecosystem services science, practice, and policy: Perspectives from ACES, A Community on Ecosystem Services. *Ecological Economics*, **115**, 1–2.