

An Approach for Assessing Ecosystem Services with Application in Albanian Part of Prespa Park

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Abstract

Nature provides us with the very essentials of life. It gives us clean air and water; enables us to produce and gather food, fuel and raw materials from the land and sea; regulates our climate; stems flood waters and it filters pollution. It also gives us personal benefits from enjoying it that increases our health and happiness. Collectively, these benefits are known as ecosystem services. A study to obtain information concerning ecosystem services issues in the Albanian part of Prespa Park (AL-Prespa) basin, south-eastern Albania, was conducted from 2010-2012. The main aim of the study was providing an assessment of services coming from a range of AL-Prespa ecosystems, and benefits of the services under different management scenarios. In this study, the problem of how to address and solve the complex issues of assessing ecosystem services is addressed, using a deliberative process based on citizens' juries aided by multi-criteria evaluation method of analysis. The main elements of the approach presented in this paper are: an inventory process to focus on sets of ecosystem services in AL-Prespa, and a number of future management scenarios are developed in conjunction with an expert panel of stakeholder and scientific representatives. This approach presents an important tool in an analysis of ecosystem services and is essential for identifying and prioritizing the relative importance of the services produced by ecosystems in a protected area. The approach described in this study may be applied to larger ecosystems with a broader range of the ecosystem services to be valued.

Keywords: Prespa Park, ecosystem services, multi-criteria evaluation method, deliberative process, citizen's jury, stakeholders.

1. Introduction

Ecosystem services have been defined by Daily [11] as the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. Ecosystem services are the benefits that people derive from nature. Some benefits, such as crops, fish, and freshwater (provisioning services), are tangible. Others such as pollination, erosion regulation, climate regulation (regulating services) and aesthetic and spiritual fulfillment (cultural services) are less tangible. The term "ecosystem services" have been coined to describe the processes and conditions by which natural ecosystems sustain and fulfill human life [9, 10, 11, 18, 19, 20, 23]. To enable the concept of ecosystem services to be applied in practice it is vital to both document and study the nature of the services provided by ecosystems and assess the value or importance (in economic and other terms) of the services in various decision contexts [4, 11].

Despite their critical importance, the capacities of ecosystems to provide these myriad services are being degraded at an alarming rate. In 2005 the Millennium Ecosystem Assessment [17], a four-year study of the state of the world's ecosystems involving more than 1,300 experts from 95 countries, reported that over 60 percent of ecosystem services were already degraded. Concern has been growing over the last half century as evidence of decline in the world's ecosystems grows and ecologists, economists and other social scientists debate the underlying socio-economic causes.

In this study, the problem of how to address and solve the complex issues of ecosystem services assessment is addressed using a deliberative process [8, 21, 24] aided by multi-criteria evaluation method of analysis [3, 7, 12, 16]. The combination of multiple criteria decision analysis (MCDA) and deliberative planning is an approach that has been applied in complex decision-making situations where multiple criteria of very different natures are considered, and several stakeholders or social groups are involved.

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MCDA was developed to help rank several alternatives from the worst to the best based on multiple, often conflicting, criteria [2]. One of the main advantages of MCDA is that it allows consideration of a large number of criteria that may be measured on completely different scales, unlike other assessment methods such as classical risk analyses [13]. This method is considered to provide relevant and reliable results [5, 14, 25].

In this paper is reported on the inventory process and options for managing ecosystem services developed and tested in a case study of the AL-Prespa in south-eastern Albania. The process included a preliminary ranking of the importance of individual ecosystem services to land uses and activities in the area, and identification of major decision scenarios for the future.

2. Material and Methods

2.1. General Data on Case Study AL-Prespa

Prespa Park region is a good case study, as it is a wetland area of high biodiversity and long human history. Decades-long efforts to draw attention to the need for the protection of Prespa region were crowned on the World Wetlands Day, February 2nd, 2000, when the three Prime Ministers through jointly signed Declaration, confirmed the establishment of transboundary Prespa Park. They also issued a wide mandate for “enhanced co-operation among competent authorities in our countries with regard to environmental matters”, and especially consideration of joint actions [22]. The whole basin is characterized by increased migration rates especially of the young, difficulties in trading of local production, disability to adapt to new technologies and challenges, limited participation in decision-making, inadequate social facilities, unemployment and inability of local people to explore and use sustainably the area’s competitive advantages.

The Prespa area in Albania, in 1999 was designated as a National Park not only due to the specific geographical features, but and for its very high biodiversity, extremely rich flora and fauna and exceptional beauty; versatile cultural and traditional elements, valuable ecological sites, good food, picturesque villages and historical layers of Byzantine and Ottoman monuments are spread across the basin. The distribution of villages and people located around the two Prespa lakes shows that approximately 5,370

persons live in 12 villages, of which 75% are employed in agriculture. Livestock and fishing also contribute to the locals income. Farming consists primarily of small-scale production for personal consumption. It is labor intensive, with women’s labor particularly important in crop production, and men’s labor crucial in animal husbandry. Livestock husbandry is integral to the farming system. Thus, almost all of the households hold one or two cows mainly for milk, ten to fifteen chickens and a few sheep and goats. The total number of agricultural holdings is about 1,450 and they are all mixed holdings (agriculture and livestock breeding). Recently a notable tourism “boom” began in its coast, almost 27 km long [22].

2.2. *Deliberative Multi-criteria Evaluation Method Procedure*

In this study, the steps followed by deliberative multi-criteria evaluation approach were as follow: **(a) Choosing the Citizen’s jury** based on the demographic overview of the population that was affected by the decision. The choice of jurors was made using a random sample of this relevant population; **(b) Choosing the options and objectives** which reflected the desired outcome of the decision making process to give clear and unambiguous purpose to the chosen option; **(c) Selecting the criteria.** The jury was given the task of selecting the criteria which were designed to compare and assess each of the options and therefore related to the overall objective of the decision-making task; **(d) Weighting the criteria.** In multi-criteria evaluation method, the preferences of the decision-maker were accounted for by the weighting placed on each of the criteria and sub-criteria. In this study, the citizen’s jury process was used in determining the weights of the criteria. The jurors discussed the relative merits of each of the criteria and call expert witnesses to help them reach a consensus on the weights; **(e) Assessing the options.** Beside the weightings of the criteria, the second component required in a multi-criteria evaluation is the assessment of the options with respect to each individual criterion. The result of this multi-criteria assessment was an impact matrix, where each of its elements represents the evaluation or impact of an option according to a particular criterion. Each criterion identifies a rank order of options determined by the degree to which each option performs in the particular criterion, and

(f) *Aggregating the criteria.* In order to obtain a single compromise rank order, these multiple rank orders have to be aggregated in some way. There exists a wide range of aggregation algorithms [1, 12]. The aggregation procedure used in this study is based on the PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) multi-criteria decision aid which uses an outranking procedure as the basis of its evaluation [6]. This procedure was utilized through the software program ProDecX which is also able to explicitly account for uncertainty when assessing various options [15]. In ProDecX, for each criterion, the weights are sampled from the weights given by the jurors in a fair way; i. e. the weighting of each decision-maker contributes equally to the final results.

3. Results and Discussion

3.1. Inventory of Ecosystem Services in AL-Prespa

The objectives of the inventory phase of this study were to: **a)** describe the full range of goods (products) produced from the environment in the study area; **b)** identify the dependence of these products on ecosystem services; **c)** identify the ecosystem services of highest priority for further study and management.

Studying every ecosystem service is impossible, so was used a participatory inventory process to select

services important to the AL-Prespa community. The first step was to work with local stakeholders to assemble a comprehensive list of products from ecosystems that people value in economic or other terms. These products included tangible, marketable commodities such as beef, wool and wheat, less tangible, marketable products like recreational opportunities, and intangible, often unmarketable products like aesthetic beauty, sites of cultural importance and intellectual or spiritual stimulation. These products were identified through two workshops involving scientists, economists, and representatives from agriculture, agencies and the general community within the AL-Prespa. Then, using this list of products/goods, the ecosystem services involved in the transformation of natural assets into those products/goods was derived. Once the goods produced, and the role of ecosystem services were identified, the services were ranked in an iterative process involving local stakeholders and scientific experts. This process was fraught with difficulty because of the interconnected nature of the services and the different perceptions of the services people receive from ecosystems. Therefore, considerable effort was made to consult a wide range of stakeholders and experts.

Ten major ecosystem services were identified and assessed against 10 groupings of land-uses and activities (Table 1).

Table 1. Summary of ecosystem services inventory for the AL-Prespa

Ecosystem services	Land uses and activities									
	1	2	3	4	5	6	7	8	9	10
a. Life fulfillment	■	■	■	■	■	■	■	■	■	■
b. Regulation of climate	■	■	■	■	■	■	■	■	■	■
c. Biodiversity	■	■	■	■	■	■	■	■	■	■
d. Provision of genetic resources	■	■	■	■	■	■	■	■	■	■
e. Maintenance and regeneration of habitat	■	■	■	■	■	■	■	■	■	■
f. Maintenance of soil health	■	■	■	■	■	■	■	■	■	■
g. Maintenance of healthy water bodies	■	■	■	■	■	■	■	■	■	■
h. Water filtration and erosion control	■	■	■	■	■	■	■	■	■	■
i. Waste absorption and breakdown	■	■	■	■	■	■	■	■	■	■
j. Aesthetic/scenic values	■	■	■	■	■	■	■	■	■	■

Shaded cells are high-priority interactions between ecosystem services (rows) and land uses (columns) as judged by expert opinion.

Key to column headings (land use): **1** – agricultural farming; **2** – livestock breeding; **3** – forestry; **4** – fishing; **5** – tourism; **6** – fruits and grapes; **7** – vegetables; **8** – grazing; **9** – management of solid waste and uncontrolled wastewater discharge; **10** – areas of cultural and historical options. Key to row headings (ecosystem services): **a** – life fulfillment; **b** – regulation of climate; **c** – biodiversity; **d** – provision of genetic resources; **e** – maintenance and regeneration of habitat; **f** – maintenance of soil health; **g** – maintenance of healthy water bodies; **h** – water filtration and erosion control; **i** – waste absorption and breakdown, **j** – aesthetic values.

Some ecosystem services, i.e. provision of genetic resources, are very important to a range of land uses but only appear to be of high priority as defined above for a few. Other services, like waste absorption and aesthetic values, appear to be at high priority points for most land uses. The local stakeholders and scientific experts placed overwhelming importance on only seven of the ten ecosystem services considered (life fulfillment, regulation of climate, biodiversity, maintenance and regeneration of habitat, maintenance of soil health, maintenance of healthy water bodies, water filtration and erosion control). The process demonstrated that decisions on natural resource management can be very different when information on a full range of ecosystem services is available. It also demonstrated to the researchers and the decision-makers the importance of identifying the right questions to be asking and having the right information available in an appropriate form as part of the decision process.

3.2. Options for Managing Ecosystem Services in Study Area

The third workshop was held and was run as a citizen's jury, which procedure was to develop a set of options related to ecosystem services in AL-Prespa and to identify some criteria for assessing these options. Eleven people of citizen's jury were attended and five experts were called as witnesses. The jury was given the task of selecting the criteria which were designed to compare and assess each of the options and therefore related to the overall objective of the decision-making task. The jurors discussed the relative merits of each of the criteria and call expert witnesses to help them reach a consensus on the weights. A probabilistic multi-criteria evaluation software tool, called ProDecX, was used interactively to aid the citizen's jury members in their deliberations.

Table 2. Impact matrix

Criteria	Indicator	Options				
		1	2	3	4	5
Maintenance of water quality	mg/l P	0.02	0.005	0.05	0.1	0.0
Biodiversity	QI ¹	7	10	4	5	10
Nutrient management/waste assimilation	QI	3	8	7	3	8
Maintenance of healthy water bodies	ISC ²	35 - 41	42 - 50	35 - 41	26 - 34	35 - 41
Maintenance of soil health	QI	5	8	7	4	8
Water filtration and erosion control	QI	7	10	6	2	9
Aesthetics views	QI	5	8	6	2	9
Public access	QI	5	1	7	9	10
Cultural/heritage sites	BI ³	1	1	1	1	1

¹QI = Quality Index: high = 10, low = 1; ²ISC = Index of Stream Condition: very poor = 0 – 19; poor = 20 – 25; moderate = 26 – 34, good = 35 – 41, very good = 42 – 50; ³BI = Binary Index: 1 = present, 0 = not present.

The selected options were: **1.** Continue current land uses; **2.** Maximize ecosystem services; **3.** Maximize social benefits; **4.** Maximize economic benefits; **5.** Sustainable production, environment, society. In this approach, each option was scored with respect to a set of indicators for each group of criteria. The options workshop also helped to identify the relevant assessment criteria. Nine criteria have been applied for the five options (Table 2).

Finally, the impact matrix showing the value of each of the different criteria under each of the different options was completed (Table 2). The matrix

included both qualitative and quantitative indicators as well as ranges for some indicators that were uncertain. Decision criteria are listed in the left-hand column followed by the indicator used to assess the criteria. The quantitative and qualitative values assigned to the criteria from available data and expert judgment form the body of the table 2.

The results taken by ProDecX run indicated a top ranking of sustainable production, environment, society option (option 5).

The next best options were maximize ecosystem services, maximize social benefits, maximize economic benefits, and lastly, continue current land use.

4. Conclusions

This paper has revealed the development of a deliberative multi-criteria evaluation approach for assessing change in the provision of ecosystem services under alternative management scenarios. This approach provides a useful tool for analyzing changes in ecosystem services as a result of different management actions. Some practical steps on how this might be achieved have been presented here and these steps were applied to a case study identifying and prioritizing ecosystem services in the AL-Prespa, Albania. The process identified to the decision-makers the importance of breaking down the decision problem and consequently being able to investigate the correct information to try and solve the problem.

The approach presented above is an important tool in an analysis of ecosystem services and is essential for identifying and prioritizing the relative importance of the services and goods produced by ecosystems. This was essentially a process to engage a wide range of stakeholders in thinking about the study area's values and challenges and to identify where is needed a more detailed quantitative analyses.

The key feature of the approach is its use to engage a broad segment of society in understanding and debating the benefits and costs of decisions that affect natural ecosystems. We are suggesting this approach as a complement rather than an alternative to more traditional approaches to decision making based on economics and policy or political sciences.

A high priority for future work is to analyze the institutions needed to maintain ecosystem services, and in particular explore ways of matching the scale and the design of institutions to the scale and nature of the ecosystem processes they are intended to influence. Another priority is to explore the feasibility of markets for ecosystem services, including the supporting institutions.

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