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Development and Testing of an Innovative Model for Managing Ecosystems in the Rački Ribniki–Požeg Landscape Park

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Abstract

The article presents the process of designing and testing an ecosystem-based governance model (EBGM). The EBGM is an innovative and highly participatory approach to addressing management challenges in protected areas. The implementation of the EBGM makes it possible to define a management approach that seeks to balance the interests of various stakeholders, ensure the long-term availability of ecosystem services, and meet the conservation goals of nature protection in important areas. The study focused on Natura 2000 sites affected by climate change (altered precipitation patterns, higher temperatures, more frequent natural disturbances, the spread of invasive alien species, etc.) while also facing management challenges (conflicting stakeholder interests, lack of management capacity, preparation of management plans, etc.). The EBGM consists of six elements, representing phases in the search for shared governance solutions. It incorporates seven fundamental principles and three key management dimensions. The model was developed iteratively and tested in practice through two participatory workshops involving key stakeholders of the Rački ribniki–Požeg Landscape Park, which, at the time of the study, was undergoing a revision of its protection act and the preparation of a management plan. The outcomes of testing the EBGM included the establishment of a stakeholder network, an assessment of the park's importance for nature conservation and provision of ecosystem services, an evaluation of past and future development trends, and the delineation of management zones for the entire area of the park. The EBGM is sufficiently flexible to be applied in other contexts and under different ecosystem management regimes.

Keywords: ecosystem services; protected areas; spatial analysis; participatory approach; ecosystem governance model; management zones

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1. Introduction

1.1. Nature Management

In Slovenia, protected areas are an integral part of the country's nature conservation system and represent contiguous areas of nature where both biotic and abiotic factors interact. Their primary goal is the preservation of nature, cultural heritage, and natural processes, which take precedence over other interests. Human activities and interventions such as land use, settlement, construction, or public infrastructure within these areas must be consistent with and balanced against the natural characteristics of the site [1]. Due to their spatial extent, protected areas significantly influence development at both local and regional scales. Despite their clear conservation purpose, protected areas are not only zones

of nature protection but also places where the identity of the landscape and the communities living within it is safeguarded. The interconnection of nature and people in these areas means that the preservation of ecosystems and their ecological potential is essential not only for biodiversity but also for the sustainable use of land and resources and for ensuring key benefits of nature, such as drinking water, food, or flood protection [2,3]. Effective management of protected areas must, therefore, be based on a multidisciplinary approach that integrates ecological, cultural, social, and economic aspects [4–6]. Such an integrated perspective contributes to achieving conservation goals and a shared development vision for the area [7], which can only be realized through an appropriate management model.

A governance model is an integrated system of objectives, actions, and outcomes based on the interconnections among stakeholder groups, their motivations, and their professional and leadership capacities, with the aim of improving nature management [8,9]. Various forms of governance models for protected areas exist, such as governance by the government, private governance, governance by indigenous people and local communities, and types of shared governance [4]. Successful nature management requires the alignment of local interests with management objectives, which is conditioned by legitimate and fair engagement of stakeholders, facilitated by consulting and building compromises [10]. Previous studies have reported several positive outcomes of involving stakeholders in governance of protected areas, such as improved ecological condition and social outcomes, fewer conflicts, and, therefore, stronger local support for conservation efforts, enhanced cooperation among stakeholders that also enables empowerment and local impact, and, finally, stronger trust among all involved [11–14].

The ecosystem-based governance model (EBGM) is a form of management model based on the understanding that human social systems are closely interconnected with ecological systems. Unlike other management models, the EBGM not only examines consequences but also explores the underlying causes and stakeholders influencing them. The model acknowledges the inseparable relationship between ecological, social, and economic factors and, through its approach, strives to balance regional development with the limits and capacities of ecosystems [15]. This interconnection has also been confirmed by recent research in natural and social sciences [3,5,16,17].

1.2. Characteristics of the Ecosystem-Based Governance Models (EBGMs)

In this study, we developed and tested an EBGM in a protected area in Slovenia. Its central premise is the sustainable management of ecosystems to ensure the provision of ecosystem services (ESs) under current and future climate scenarios. At the same time, the model accounts for the influence of various stakeholder actions, which may result from the implementation of national and local policies or from traditional practices in agriculture, forestry, or water management. Emphasis is, therefore, placed on the role of stakeholders, which is essential in ecosystem management. The EBGM is based on the premise that the participation of diverse societal groups in decision-making and practical management is crucial. This aligns with the Aarhus Convention [18], which emphasizes the role of a healthy environment in human well-being. Citizens must, therefore, be enabled to actively participate in protecting and improving the environment, with access to information and the means for meaningful participation in environmental decision-making.

The participation of diverse stakeholders strengthens the legitimacy of decisions, builds trust among them [19], supports more reliable outcomes by incorporating traditional knowledge and experience [20,21], and helps overcome obstacles and conflicts in planning measures to improve ecosystems [22]. In the EBGM, the participatory element is embedded into all possible phases of the process, thereby:

- Strengthening the comprehensiveness of decision-making in nature management (diverse perspectives, synergies and compromises, addressing challenges);
- Ensuring inclusiveness, fairness, conflict resolution, and accountability;
- Enabling the development of decision-making capacities and learning (knowledge sharing, empowerment, adaptive management, institutional competencies);
- Promoting sustainable management and the resilience of ecosystems to climate change.

The development of an EBGM must also address common challenges to participation, such as ensuring the involvement of relevant stakeholders, reconciling diverse (and often conflicting) interests, power imbalances, ecological constraints in the availability of ESs, knowledge gaps, poorly articulated objectives, and maintaining long-term stakeholder engagement.

The EBGM is intended as a tool for managers of protected areas, defining the rules of conduct within protected sites. In theory, protected areas are required to adopt a management plan that sets out development goals and priorities across different sectors. In Slovenia, in accordance with Article 60 of the Nature Conservation Act [23], the management plan for a protected area defines development guidelines, methods implementing protection, use, and management, and detailed guidelines for protecting natural values, while considering the needs of local communities. Under Article 53 of the Act, such plans are mandatory for national and regional parks. To achieve the objectives, specific measures are usually defined and measurable through indicators. These indicators, defined for each measure using quantitative or qualitative criteria, are benchmarks by which managers assess progress in achieving intended results and objectives. Through its integrated management approach, the EBGM strives to establish a balance between the needs of human society and ecosystems, with the explicit goal of ensuring the sustainable use of natural resources [15]. One of the most important indicators of effective natural resource management is the sustained availability of ESs [6].

1.3. Research Objectives

Building on the existing need for integrated nature management, we explored a novel governance approach that directly addresses various, possibly conflicting, stakeholders' positions and interests, as well as a lack of capacity, and focuses decision-making on the sustained provision of ESs. The key objective of this research was twofold. First, we conceptualized and designed an innovative EBGM model by defining its theoretical framework based on a system of fundamental principles and key management dimensions to ensure comprehensive and inclusive governance. Second, we tested the EBGM using the case of the Rački ribniki–Požeg Landscape Park, a Natura 2000 site that was undergoing a revision of its management plan at the time of this study, to observe the feasibility of implementing the EBGM in a real-world context with multiple stakeholders. Overall, the study aims to deliver an adjustable tool that managers of protected areas could use to facilitate participation, balance nature conservation goals with the socio-economic needs of local communities, and establish a foundation for management planning.

2. Materials and Methods

The development of the EBGM followed the objective of strengthening capacities for sustainable ecosystem management that can continue to provide ESs to local residents of protected areas and other stakeholders. Methodologically, the research approach is divided into several components that differ in the methods applied yet are structured as interconnected phases. First, the design of the EBGM is described, together with the basic principles on which the model is based. This is followed by a description of the study area where the EBGM was tested. The following part outlines the approach to mapping

and selecting key stakeholders, who were involved in a participatory process to identify relevant ESs, define trends in their development, determine the influence of stakeholders on ESs, and identify conflicts in the area. The process of assessing ES availability and the formation of management zones based on this assessment are also described. All phases, except for the last two, were carried out in a participatory manner, either via workshops or through additional meetings.

2.1. Ecosystem-Based Governance Model (EBGM)

2.1.1. Fundamental Principles and Theoretical Framework of the EBGM

In designing the EBGM, we incorporated seven fundamental principles, which are realized through its practical implementation and are reflected, directly or indirectly, in its individual elements. The set of principles builds on previous research [8,9] and our own conceptual contributions. They are briefly outlined below.

1. Participatory management involves the active engagement and collaboration of relevant stakeholders—local communities, sectoral government agencies, managers, non-governmental organizations, and the private sector—in decision-making processes concerning ecosystem management. Their role should go beyond mere consultation and be embedded in active governance structures that are legitimate and reflect the needs and aspirations of those most affected by management decisions.
2. Adaptive management requires flexibility and responsiveness to new information, changing environmental conditions, and emerging socio-economic factors. The management process is thus a continuous effort to adjust to new circumstances, based on monitoring the effects of past actions while simultaneously planning future interventions.
3. Transparency and accountability must be ensured throughout decision-making, the allocation and use of financial and human resources, and the evaluation of management effectiveness. This requires a comprehensive monitoring and reporting mechanism combined with a clear hierarchy of responsibilities among individuals and organizations.
4. Equality and social justice should guarantee a fair distribution of both the costs and the benefits arising from ecosystem governance. This is essential to prevent specific social groups from bearing a disproportionate share of management burdens and to ensure that everyone has access to natural resources (ecosystem services) and the opportunities they provide.
5. Ecosystem integrity is a fundamental principle requiring the preservation and enhancement of biodiversity, ecological processes, and ESs. This principle should guide all governance decisions, which must not exceed ecological carrying capacities and must maintain ecosystem resilience.
6. Empowering local communities (polycentric governance) allows for the distribution of authority and responsibility across different stakeholder groups. These groups are autonomous but interconnected and must coordinate with each other in decision-making.
7. Inclusion of local and traditional knowledge reflects recognition of the importance of knowledge held by local communities, based on established management practices and valuable experience—including lessons learned from past mismanagement. This knowledge should be applied alongside contemporary insights supported by scientific research.

The EBGM thus integrates these fundamental principles while also building on a system of elements—management objectives, measures, and outcomes; stakeholder groups and their interdependencies; and professional and management capacities. These elements are designed to enable comprehensive ecosystem governance, particularly in the context of changing socio-economic conditions and climate scenarios. Both factors introduce

greater uncertainty and risk, requiring more integrated management. In this sense, the EBGM recognizes the close interconnection and mutual dependence between society and ecosystems. The model is meant to operate within the existing legislative context, which pre-defines the roles and responsibilities of individual stakeholders in the governance of a protected area. None of the direct outcomes of the EBGM's implementation refers to organizational changes in governance; however, they might act as triggers for future reconsideration of stakeholders' responsibilities.

The EBGM also incorporates three essential management dimensions: (1) the process of joint decision-making, (2) the search for shared solutions and conflict resolution, and (3) the effective allocation of management resources (people and funding). These are general dimensions, meaning that the EBGM can also be applied in other natural resource management contexts, not only in protected areas, as demonstrated in this study. The fundamental principles of the EBGM are embedded throughout all three management dimensions.

2.1.2. Development of the EBGM Design

Methodologically, the design of the EBGM was shaped through a combination of a review of previous research on natural resource and protected area governance models, original conceptual innovation, and several iterative rounds of discussion and evaluation of the initial framework with external experts (colleagues from Høgskulen for Grøn Utvikling, HGUt, Bryne, Norway). We referred to three existing nature governance models and considered selected elements: the role of local communities, as in community-based natural resource management [24], use of a continuous feedback loop within the action–effect concept, as in adaptive governance [25], and holistic considerations of ecosystem capacity, as in ecosystem-based management [26]. The core foundations of the EBGM were informed by the objectives of the Norwegian Financial Mechanism program (https://www.norwaygrants.si/en/ (accessed on 1 December 2025))—under which this study was implemented—and by the developmental challenges of the pilot area, the Rački ribniki–Požeg Landscape Park. These challenges were identified through targeted meetings with representatives of the Institute of the Republic of Slovenia for Nature Conservation (ZRSVN, Maribor regional unit and the central office), from existing management planning documents for the park, and from previous studies on the condition of protected habitats and habitat types.

Building on the aforementioned review of prior research on the EBGM and the specific issues identified in the pilot area, we iteratively developed the EBGM structure according to the assumptions and context of its fundamental principles and management dimensions. This process involved multiple iterations to refine the EBGM elements and their interconnections, followed by critical evaluation of the draft model and subsequent revisions. The resulting EBGM is a hierarchical system of phases or processes that are implemented sequentially, though some may also occur in parallel, depending on the context. We defined the EBGM structure by linking the individual elements of the model to the fundamental principles of its theoretical framework and to the management dimensions embedded within it. This is presented in illustrative and schematic form in Table 1.

Table 1. Ecosystem-based governance model (EBGM) with the integration of fundamental principles and natural resource management dimensions, together with the section references describing the methodological approach and the EBGM test results.

Elements of the EBGM	Fundamental Principles of Natural Resource Management	Dimensions of Natural Resource Management			EBGM Test Results in the Rački Ribniki–Požeg Landscape Park
Definition of context		Joint decision-making	Search for common solutions and conflict resolution	Effective allocation of management resources	
Definition of the management challenge	Ecosystem integrity	■			Context of the study area (Section 2.2)
Identification of relevant stakeholders	Participatory management	■			Participatory approach and stakeholder mapping (Sections 2.3 and 3.1)
Jointly defined goal of future management	Empowerment of local communities	■			Context of the study area (Section 2.2); identification and ranking of ES importance (Sections 2.3 and 3.2); identification of conflicts in the area (Sections 2.3 and 3.5)
Action plan to address challenges	Transparency and accountability		■	■	Identification of stakeholders and factors significantly influencing ES availability (Sections 2.3 and 3.4); identification of conflicts in the area (Sections 2.3 and 3.5)
Communication plan	Empowerment of local communities			■	Developed within the ZAGON project, but not as part of the EBGM development process
Review and prioritization of ecosystem services					
Selection of relevant ESs	Ecosystem integrity	■			Identification and ranking of ES importance (Sections 2.3 and 3.2)
Dependence between ESs and past management	Adaptive management		■		Description of past and future trends (Sections 2.3 and 3.3)
Areas of conflict between different land uses	Participatory management		■		Identification of conflicts in the area (Sections 2.3 and 3.5)
Assessment of state, trends, and trade-offs					
State and trends of ESs	Ecosystem integrity			■	ES analysis (Sections 2.4 and 3.6); assessment of past and future trends (Sections 2.3 and 3.3)
Review of key drivers of change in relation to stakeholders	Adaptive management		■		Identification of stakeholders and factors significantly influencing ES availability (Sections 2.3 and 3.4)
Synergies and trade-offs between ESs	Ecosystem integrity		■		Assessment of past and future trends (Sections 2.3 and 3.3)
Key messages for different stakeholders	Participatory management	■			Developed within the ZAGON project, but not as part of the EBGM development process

Table 1. *Cont.*

Elements of the EBGM	Fundamental Principles of Natural Resource Management	Dimensions of Natural Resource Management				EBGM Test Results in the Rački Ribniki–Požeg Landscape Park
Consideration of institutional and cultural context						
Institutional, political, legislative, and cultural conditions	Transparency and accountability					Context of the study area (Section 2.2)
Causes and drivers of ES degradation	Adaptive management					Identification of stakeholders and factors significantly influencing ES availability (Sections 2.3 and 3.4)
Stakeholder attitudes, interests, needs, and rights	Participatory management					
Existing and potential areas of conflict	Participatory management					Identification of conflicts in the area (Sections 2.3 and 3.5)
Design of decision-making improvements						
Risks and opportunities associated with the management model	Transparency and accountability					Identification of conflicts in the area (Sections 2.3 and 3.5)
Opportunities within current management policies	Equity and social justice					Identification of stakeholders and factors significantly influencing ES availability (Sections 2.3 and 3.4); identification of conflicts in the area (Sections 2.3 and 3.5)
Implementation of proposed changes						
Implementation strategy and operational work plan	Transparency and accountability					Management zones (Sections 2.5 and 3.7)
Communication strategy	Empowerment of local communities					Developed within the ZAGON project, but not as part of the EBGM development process

Note: Shaded cells indicate cases where a management dimension is embedded within an EBGM element.

2.2. Study Area

The pilot area, Rački ribniki–Požeg Landscape Park (Figure 1), is a protected natural area where cooperation between local communities and nature conservation is crucial for spatial planning and management. It is located in northeastern Slovenia, in the northwestern part of Dravsko polje, a flat, alluvial plain along the Drava River. The landscape park has a high conservation value on the international and national levels. In addition to its designation as a landscape park (IUCN category V), the area also holds several other conservation statuses: five nationally designated botanical, zoological, and ornithological natural monument areas (CDDA) (IUCN category III), five natural values areas (national category of protection), one ecologically important area, and two Natura 2000 sites (SPA Črete (SI5000027) and SAC Rački ribniki–Požeg (SI3000257)). The general protection regime of the park is currently defined in Articles 64 and 68 of the Nature Conservation Act [18]. A more specific protection regime will be defined in the regulation of the landscape park, which is still in preparation. As described in the starting points of the management plan, the protection regime will encompass water infrastructure and water bodies, agricultural land and forest, and other areas in the park (i.e., roads and cycling and walking trails) [27].

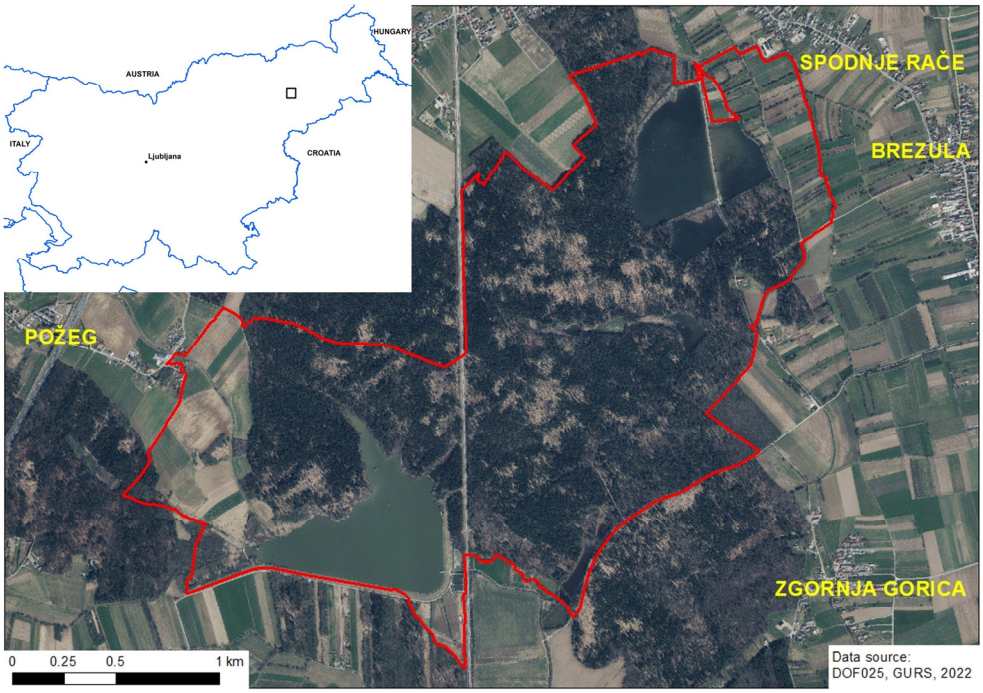

Figure 1. Rački ribniki–Požeg pilot area (location within the country shown in the top-left corner).

The main characteristics of the park are defined by aquatic ecosystems and their associated protected flora and fauna. The area is characterized by a high density of water bodies, including streams, ponds, former fishponds, and a retention reservoir fed by the Fram and Mura streams. Particularly significant are the numerous standing water bodies, with the Rački ponds being notable for their ornithological value, as almost half of Slovenia's avifauna has been recorded here. Wetland and aquatic habitats dominate the park, together with their associated plant and animal species. The core of the park consists of a complex of lowland swamp forests, predominantly broadleaved, on gleyed and waterlogged soils. Forests of pedunculate oak (*Quercus robur* L.) and European hornbeam (*Carpinus betulus* L.) prevail in terms of area, but on drier, gravelly soils, they have been partly replaced by spruce (*Picea abies*) stands. In the wettest areas, black alder (*Alnus glutinosa* L.) dominates, sometimes forming pure alder stands. Around the park's margins lie agricultural lands, primarily wet meadows interlaced with a network of hedgerows, reflecting the

once-characteristic appearance of the traditional agricultural landscape [27]. The primary protection objective of the landscape park is to safeguard its natural values and preserve biodiversity and landscape diversity. Specific protection objectives are currently mainly defined by starting points for a management plan [27] and the Natura 2000 Management Programme (https://natura2000.gov.si/en/natura-2000/natura-2000-in-slovenia/natura-2000-management-programme/ (accessed on 1 July 2025)).

The park also plays an important social role in the wider region. Agricultural and forestry activities are carried out within its boundaries, and in the past, the water bodies supported intensive fish farming. Within the park, there are several unpaved roads, which are utilized for recreational activities, primarily for cycling, running, and walking. A few routes traverse the forest and proceed alongside water bodies. The park features educational trails, equipped with information boards about protected flora and fauna and an observation tower for bird watching. Due to these features, the park is increasingly valued as a space for recreation and environmental education, catering to local communities, as well as day trippers, casual visitors, and groups of professionals [28]. However, the interplay of various protection regimes and human activities also generates conflicts, which pose challenges for the future management of the park.

2.3. ES Participatory Approaches

A key component of the EBGM is the involvement of stakeholders, as they typically act as initiators of various management activities. Stakeholders may serve as planners, implementers, and supervisors of measures, or they may simply observe the process. In all cases, their active participation—or at least their support—is essential for successful management, which requires that their interests be aligned with management objectives. Otherwise, conflicts may arise, often reflecting an unequal distribution of power among individuals or groups seeking to advance their own interests, thereby indirectly influencing both nature and ESs. The EBGM addresses these aspects by enabling managers to identify key stakeholders, understand their attitudes toward governance methods and objectives, and build alliances accordingly.

Stakeholders can be categorized according to four main criteria: interest, power, proximity, and orientation (IMPO).

Interest refers to stakeholders' needs, expectations, and preferences regarding the management of an area (3—active, 2—passive, 1—no interest). These interests may be expressed actively or passively. Understanding them is crucial for identifying synergies and preventing conflict situations.

Power reflects the capacity of an individual or group to implement or influence desired changes (4—high, 3—considerable, 2—low, 1—none). This criterion is particularly important for implementing management measures, as stakeholders with greater power are more capable of ensuring that actions are carried out.

Proximity indicates the degree of a stakeholder's involvement in management decisions and activities (4—directly involved, 3—routinely involved, 2—informed but not directly involved, 1—detached from management). Environments that promote participatory engagement generally enable more active stakeholder involvement and a more diverse composition of actors.

Orientation toward management may be positive—when stakeholders support the implementation of measures—or negative, when they obstruct activities and hinder the achievement of management goals (3—support, 2—undecided, 1—no support).

As part of testing the EBGM, key ecosystem services for the pilot area were identified through a participatory approach in two workshops held in 2023. These workshops focused on addressing management challenges in the Rački ribniki–Požeg Landscape Park and

were carried out through a multi-stakeholder partnership involving public agencies and services, non-governmental organizations, and local communities.

Four main activities were conducted: (1) identifying and ranking the importance of individual ESs, (2) assessing past and future trends in the state of ESs, (3) determining the influence of various factors and stakeholder groups on ESs, and (4) analyzing conflicts. Based on these activities, the most relevant ESs for the pilot area were identified.

1. Identification and ranking of ES importance

Stakeholders selected relevant ESs using a point scoring system. Each participant distributed 10 points among the list of ESs according to the interests of the group they represented. In the first step, the ESs were ranked by the total number of points received. To ensure objectivity, the number of points was then divided by the number of representatives within each stakeholder type.

2. Assessment of past and future trends in the state of ESs

For the most relevant ESs, stakeholders evaluated both past and expected future trends in their availability. They assessed whether each ES had improved, remained stable, or declined in the past and indicated the anticipated direction of future development.

3. Identification of factors and stakeholders influencing ES availability

For the most relevant ESs, stakeholders indicated actors who are affecting availability of ESs. They assessed whether their effect is either positive or negative.

4. Identification of conflicts in the area

Workshop participants also reflected on the most pressing problems or conflicts within the park. These were written on sticky notes and placed on a large map of the Rački ribniki–Požeg Landscape Park, enabling spatial identification of conflict zones and overlapping interests.

The results of these participatory activities were incorporated, both directly and indirectly, into the development of the EBGM for the Rački ribniki–Požeg Landscape Park.

2.4. Mapping of ES Supply

This section presents the mapping of the ES supply that stakeholders identified as most important in the pilot area. For these priority ESs, we prepared methodological protocols for their evaluation [29,30]. Each ES protocol included the key elements necessary for consistent assessment. Specifically, the content of each protocol comprised: (1) a justification of the ES, including the benefits it provides; (2) a definition of the ES, following the international CICES classification (Common International Classification of Ecosystem Services) [31]; (3) a biophysical indicator for assessing ES supply, which could be qualitative or quantitative and typically included several components; (4) a description of the methodological approach for ES assessment, including an explanation and justification of the procedure used to evaluate the ES indicator; and (5) the data sources used in the indicator assessment. The graphical output of the mapping reflects the format of the data sources used. Some data are related to actual land use (e.g., forests, arable land, water bodies, etc.) and take the form of heterogeneous polygons, while other data are linked to raster format (e.g., meteorological data, abundance of features within a rectangular area, etc.). When both data types are used to overlay individual GIS layers, a distinct mixed pattern of straight and curved lines is generated.

The ES indicators were developed according to three main criteria: the cascade model of ES assessment, the availability of data required for indicator evaluation, and the analytical skills and tools available for data processing. In line with the cascade model [32], the indicators were designed to represent the actual supply of ESs—defined as a combination of

the ecological capacity of ecosystems to provide services and the management constraints affecting their use. The remaining two components of the cascade model—use and demand for ESs—were not addressed in this study. The indicators were quantitative and expressed primarily as continuous variables.

2.5. Management Zones

Areas or locations with distinctly higher ES supply represent sites where management approaches need to be adapted accordingly—these are referred to as management zones. Higher ES supply is reflected in elevated values of ES indicators, with individual ESs grouped into three categories: provisioning, regulating, and cultural. To enable comparability among indicators, the measurement scales of individual ES indicators were normalized to a unified format of relative supply values ranging from 0 to 1. At locations where at least two ESs from the same group were present, the normalized values of their respective indicators were summed. This procedure was repeated for each of the three ES groups, and the resulting sums were again standardized on a scale from 0 to 1. The aggregated ES values within each group thus represent areas of higher supply or ES management zones. Based on the spatial overlap of areas with high concentrations of all three ES groups, we delineated the management zones, which indicate where management strategies should be coordinated and, if necessary, adjusted to maintain or enhance ecosystem service provision.

3. Results

This section follows the individual phases of the methodological approach and presents the practical implementation of the key elements of the EBGM. During the testing process, it became evident that stakeholder involvement should not be limited to joint participatory events, such as workshops, but must instead be maintained through continuous interaction. Two workshops were organized with stakeholders previously identified as key actors. They expressed their positions in terms of the identification and ranking of ESs, the assessment of past and anticipated future ES trends, the identification of stakeholders and factors influencing ES supply, and the identification of land use conflicts within the area. The mapping of ES supply and the delineation of management zones were conducted independently.

3.1. Stakeholders

The first workshop (28 August 2023) and the second workshop (14 March 2024) were attended by representatives of the following institutions: the Municipality of Rače–Fram, the Municipality of Slovenska Bistrica, RIC Slovenska Bistrica, the Society for the Study and Conservation of Birds and Nature (DPPVN), BirdLife Slovenia (DOPPS), the Rače Hunting Association, the Polskava Hunting Association, the Slovenia Forest Service (ZGS) regional units Maribor and Nazarje, Slovenski državni gozdovi (SiDG), the Maribor Agricultural and Forestry Chamber (KGZ Maribor), the Farmland and Forest Fund of the Republic of Slovenia (SKGZRS) local unit Slovenska Bistrica, the Slovenian Water Agency (DRSV), the Slovenian Forestry Institute (GIS), the Institute of the Republic of Slovenia for Nature Conservation (ZRSVN) regional units Maribor and Celje, and private landowners.

Based on the views expressed during the first workshop, we assessed the stakeholders according to the IMPO criteria (interest, power, proximity, and orientation) (Table 2) and subsequently categorized them into clearly defined stakeholder profiles (Figure 2).

Table 2. Stakeholders in the governance process of the Rački ribniki–Požeg Landscape Park, with an assessment of their interest and power in the context of governance objectives, their proximity to the governance process, and their orientation toward the park's governance approach.

	Stakeholder		**I**	**M**	**P**	**O**
	Title	Role	Interest	Power	Proximity	Orientation
1	Municipality of Rače–Fram	Park authority	3	4	4	3
2	Municipality of Slovenska Bistrica	Park authority	3	4	4	3
3	RIC Slovenska Bistrica	Development organization	2	2	2	3
4	Society for the Study of Birds and Nature	NGO (nature conservation)	3	2	3	3
5	BirdLife Slovenia (DOPPS)	NGO (nature conservation)	2	2	2	3
6	Polskava Hunting Association	Game management	3	3	3	3
7	Rače Hunting Association	Game management	3	3	3	3
8	Slovenia Forest Service (ZGS)—Maribor and Nazarje	Forestry advisory service	3	3	4	3
9	Slovenski državni gozdovi (SiDG)	State forest management company	3	4	4	3
10	Agricultural and Forestry Chamber Maribor (KGZ Maribor)	Agricultural advisory service	2	3	4	3
11	Farmland and Forest Fund of the Republic of Slovenia—Slovenska Bistrica	Representative of state-owned agricultural land	3	4	4	3
12	Institute of the Republic of Slovenia for Nature Conservation (ZRSVN)—Celje regional unit	Nature conservation advisory service	2	1	1	3
13	Institute of the Republic of Slovenia for Nature Conservation (ZRSVN)—Maribor regional unit	Nature conservation advisory service	3	3	4	3
14	Slovenian Water Agency (DRSV)	Water management authority	2	3	1	3
15	Landowners	Private landowners	3	3	3	3

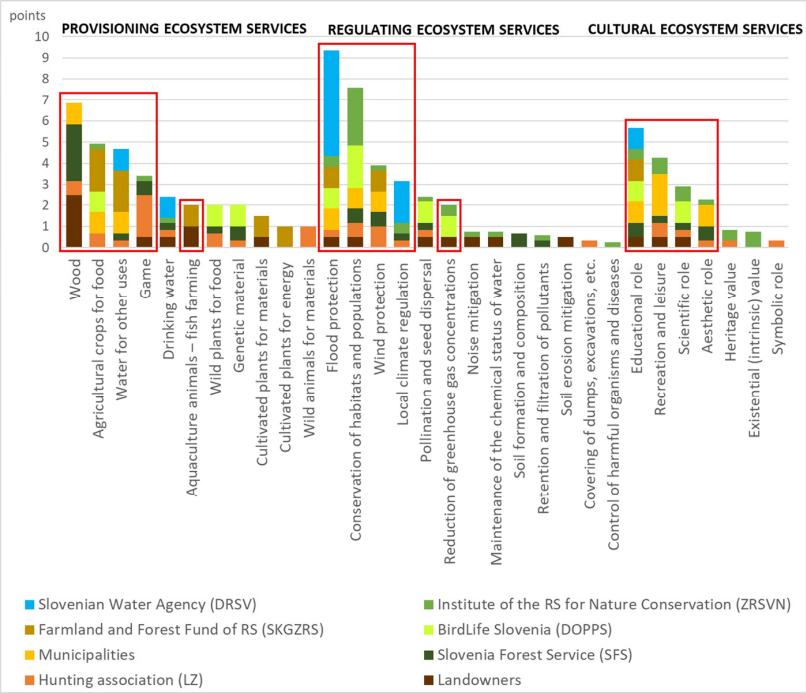

Figure 2. Assessment of the importance of ESs by stakeholder type, adjusted for the number of representatives within each stakeholder group, and selection of ESs for mapping (ESs in red rectangles were selected for mapping as key ESs for the pilot area).

3.2. ES Identification

Workshop participants identified flood protection as the most important ES in the study area, with a score of 9.3. This was followed by habitat and population conservation for reproduction and early development (e.g., breeding, spawning, and nesting sites) with 7.5 points, educational value with 5.7 points, agricultural crops for food with 4.9 points, and water for other uses with 4.7 points. The workshop took place shortly after the catastrophic floods of

2023, which likely influenced participants' responses. The Rački ribniki–Požeg Landscape Park represents a diverse mosaic of wetlands, wet meadows, forests, fields, and hedgerows. Water is a key landscape element in this area, which was also emphasized by workshop participants, since two of the five most important ESs identified are directly related to water. According to stakeholders, the most important ES is flood protection, particularly highlighted by the Slovenian Water Agency (DRSV). The Požeg retention reservoir plays a central role in this function. Constructed in the 1960s by damming the Fram stream, its purpose is to mitigate peak flood waves of the Fram and Drosarica streams, thereby preventing centennial floods downstream. Participants, especially representatives of the Farmland and Forest Fund of the Republic of Slovenia, also stressed the importance of water for irrigation ("water for other uses", ranked sixth overall). Irrigation is already practiced in the area, but they noted that the system could be upgraded in the future. The area's water bodies, as part of the broader landscape mosaic, are also of exceptional conservation importance. They provide habitats for rare and endangered plant and animal species—a fact well recognized by participants, who identified habitat and population conservation for reproduction and early development (e.g., breeding, spawning, and nesting sites) as the second most important ES, with ZRSVN and DOPPS assigning it the highest scores. Due to its high biodiversity and attractiveness to visitors, particularly given its proximity to urban areas, the park also has strong potential for environmental education. Workshop participants ranked educational value as the fourth most important ES. Finally, its location on Dravsko polje provides favorable conditions for agriculture, especially arable farming. Participants ranked agricultural crops for food as the fifth most important ES in the Rački ribniki–Požeg Landscape Park, with the Farmland and Forest Fund of the Republic of Slovenia contributing most of the points.

3.3. Analysis of Past and Future Trends

3.3.1. Assessment of Past Trends in ESs

Evaluation of past changes (Figure 3) indicated that most stakeholders observed a decline in ESs, particularly the following: conservation of habitats and populations for reproduction and early development, wild plants for materials (wood), and wild animals for food (game).

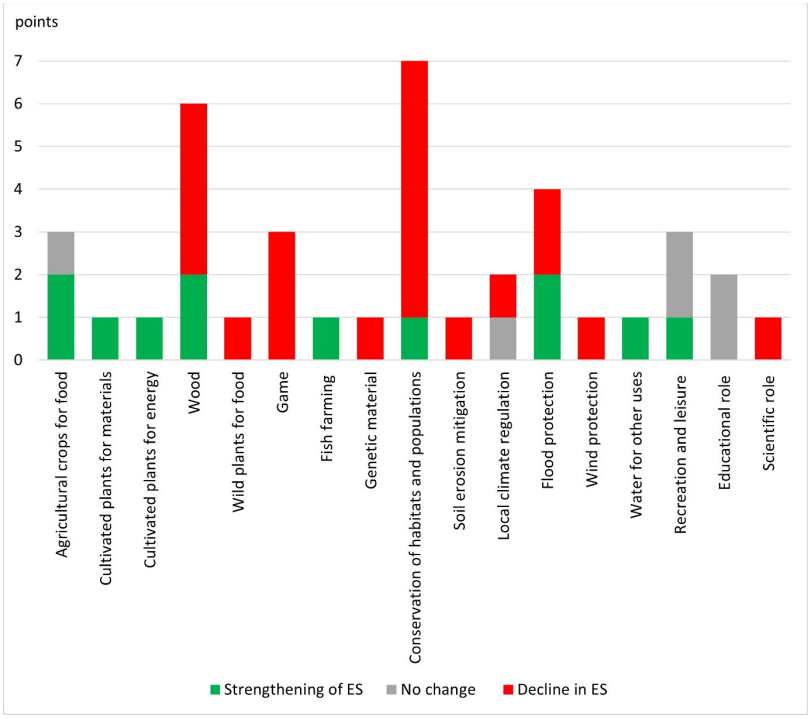

Figure 3. Stakeholders' indication of past trends in ESs.

3.3.2. Assessment of Future Trends in ESs

Evaluation of future trends in ESs (Figure 4) shows that stakeholders generally expect a strengthening of most ESs, particularly the following: conservation of habitats and populations for reproduction and early development, agricultural crops for food, and flood protection.

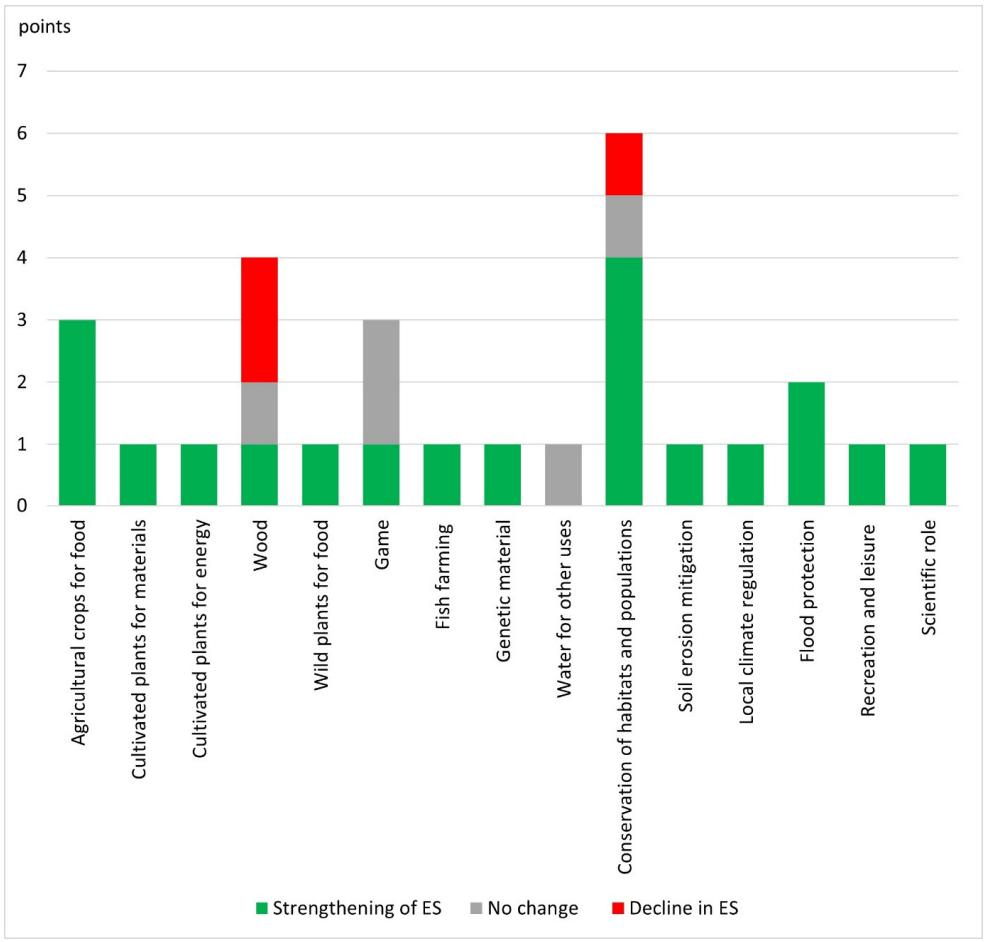

Figure 4. Stakeholders' indication of future trends in ESs.

3.4. Identifying the Stakeholders and Drivers with Past Impact on ES Supply

Workshop participants identified the stakeholders they believed had the greatest influence on ESs in the past (Figure 5). Within the group of provisioning services, stakeholders considered that wood was most strongly influenced by forest owners, followed by foresters and the general public. Agricultural crops for food were seen as primarily shaped by farmers, with a lesser influence from agricultural cooperatives and the state. For livestock for food, participants judged that farmers and agricultural cooperatives had equal influence. In the case of game, the greatest impact was attributed to the general public, particularly through recreational activities.

Among regulating services, participants most frequently assessed the influence of stakeholders on habitat and population conservation for reproduction and early development. They believed this ES was most affected by fish farmers, followed closely by the general public and farmers. For flood protection, participants considered fish farmers, the state, the general public, and other organizations to have had equally significant influence.

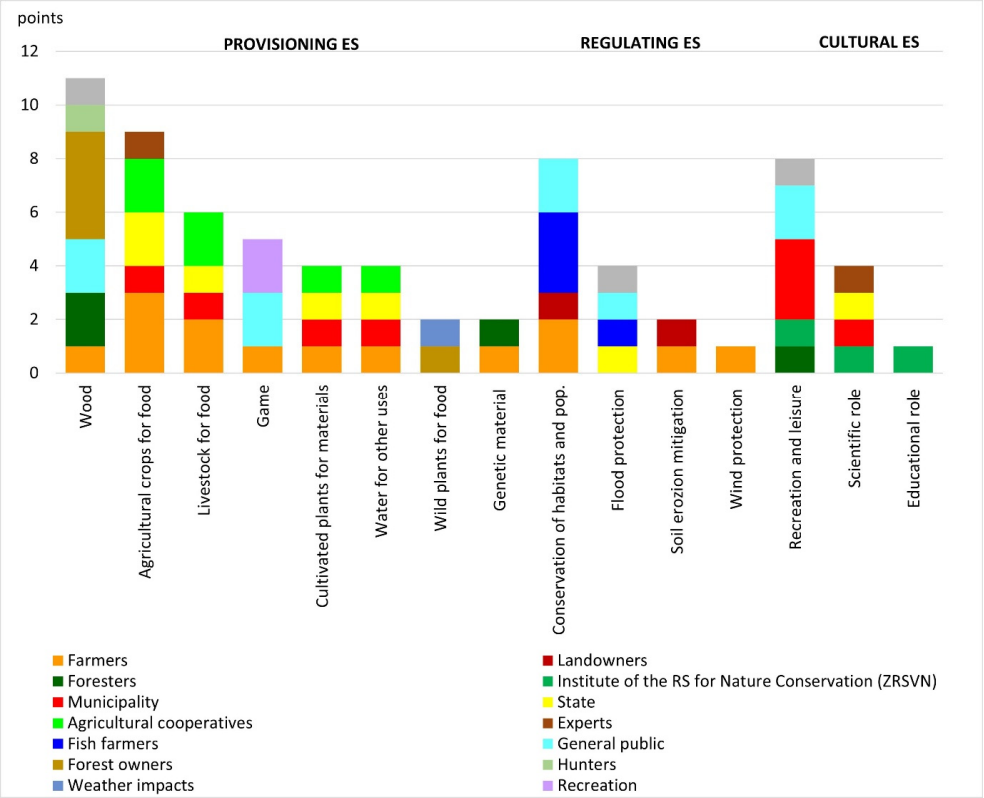

Figure 5. Stakeholders identified as having the greatest influence on past ES supply.

For cultural services, participants most often evaluated the role of stakeholders in recreation and leisure, identifying the municipality as having the strongest influence, followed by the general public. For scientific value, participants attributed equal influence to the Institute for Nature Conservation (ZRSVN), the municipality, the state, and the scientific community.

3.5. Identification of Conflicts in the Area

Stakeholders identified more than ten conflicts in the study area and mapped their locations (Figure 6). In their view, most conflicts stem from inadequate land management—such as poorly maintained water bodies, inappropriate forest management, unsuitable forms of recreation, improper visitor behavior, and unregulated parking—which runs counter to conservation objectives and negatively affects biodiversity. For each conflict group, measures and guidelines were also proposed to mitigate or prevent these issues. Some were adapted from the professional basis for the park's designation [27], while others were developed through consultation with workshop participants.

Since intensive fish farming has largely ceased (except at the Požeg pond), water infrastructure has deteriorated and surfaces have become overgrown, negatively affecting biodiversity. Without substantial, financially supported projects, participants believe it will be difficult to restore or even maintain the current condition of water bodies. They emphasized the need to ensure active management of aquatic habitats within the Račkі ribniki–Požeg Landscape Park. Proposed measures include maintaining permanent water surfaces, regulating fish population structures and removing non-native species, restoring damaged embankments, and creating backwaters, inlets, and oxbows.

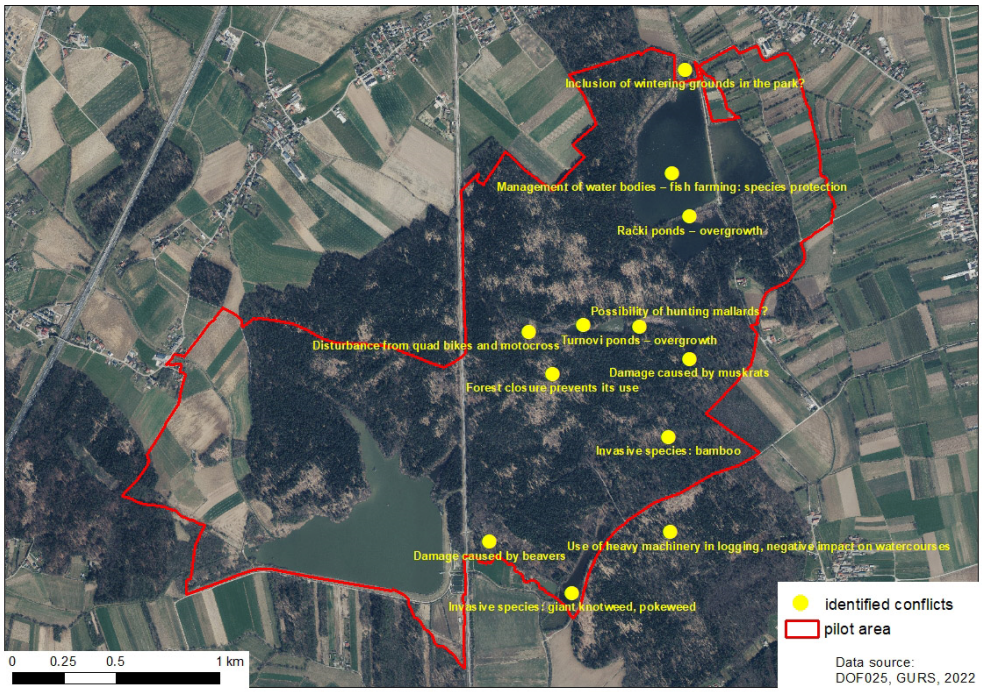

Figure 6. Conflicts identified in the Rački ribniki–Požeg Landscape Park and their spatial distribution.

Another major problem is the spread of invasive alien plant species, particularly giant knotweed (*Reynoutria sachalinensis* F.Schmidt), bamboo, and American pokeweed (*Phytolacca americana* L.), which pose a threat to biodiversity and endanger native vegetation. Improvement measures include the removal of invasive alien plant and animal species, with eradication methods agreed in advance with the competent public service.

Stakeholders also highlighted the negative effects of inappropriate logging practices, especially the use of heavy machinery. In some cases, drainage ditches were filled in or redirected, embankments were damaged, and water no longer accumulated in the ditches but spread into the forest, resulting in waterlogging. Contractors often failed to restore affected surfaces after logging, which further exacerbated environmental degradation. Suggested mitigation measures include conducting operations during winter when soils are frozen, restoring extraction tracks after logging, and coordinating activities among multiple landowners to reduce the frequency and extent of disturbances.

Due to its proximity to urban areas, the park experiences high visitor pressure, leading to problems related to inappropriate behavior and unsuitable recreational activities, such as quad biking and motocross. Spontaneous parking in natural areas also occurs, as the park lacks adequate infrastructure and designated parking facilities. To improve visitor management, proposed measures include preparing a traffic plan (including parking regulations), periodically closing forest tracks, establishing a bicycle rental system, and organizing volunteer clean-up events that also serve to raise public awareness of the park's specific features and management requirements.

Workshop participants also identified several additional conflicts in the Rački ribniki–Požeg Landscape Park, including damage caused by beavers and muskrats, restricted forest access that limits its use, hunting of mallards, and the potential inclusion of wintering grounds currently located outside park boundaries. Mallard hunting is particularly problematic, as the species coexists with other strictly protected bird species for which hunting is prohibited, thereby increasing the risk of unintentional shooting of protected species.

3.6. Mapping of ES Supply

For the assessment, mapping, and detailed analysis, we selected the ESs (Figure 2) that stakeholders had identified as most important in the pilot area—specifically, the four highest-ranked services from each ES category according to the number of votes. Following consultation with representatives of the Institute of the Republic of Slovenia for Nature Conservation, Maribor Regional Unit (ZRSVN OE Maribor), we also included aquaculture animals—fish farming—and greenhouse gas concentration reduction in the further analysis. The ES wild plants for materials (timber) and wild plants for energy (fuelwood) were combined into a single ES: wild plants for material and energy—wood. For the ES water for other uses (e.g., irrigation) and aquaculture animals—fish farming—the data collection process revealed insufficient data for objective analysis and mapping; therefore, these services were excluded from further consideration. The ES aesthetic value and recreation and leisure were analyzed jointly due to their strong interconnection. For the ES scientific role, data collection showed that, based on the evaluation indicators, it was not present in the pilot area. The ES educational role was not scored or included in the ES clustering maps; however, linear and point features related to it were displayed on the map alongside the aesthetic and recreational ESs.

3.7. Concentration of Availability of ESs and Management Zones

The individual ESs were grouped into three categories—provisioning, regulating, and cultural services—and locations of higher and lower availability were displayed on composite maps. These locations represent concentrations of ESs and are presented in three cartographic representations for the Rački ribniki–Požeg Landscape Park (Figures 7–9).

Provisioning ESs are more strongly concentrated in the northeastern and western parts of the area (Figure 7), particularly where agricultural land—fields and meadows—predominates. In the central and southern parts of the park, concentrations of provisioning ESs are less pronounced, as these areas are dominated by forests that have been damaged in the past and only partially regenerated, which currently reduces their productive capacity. The decline in the vitality of certain key tree species was already identified as a management challenge in the contextual analysis.

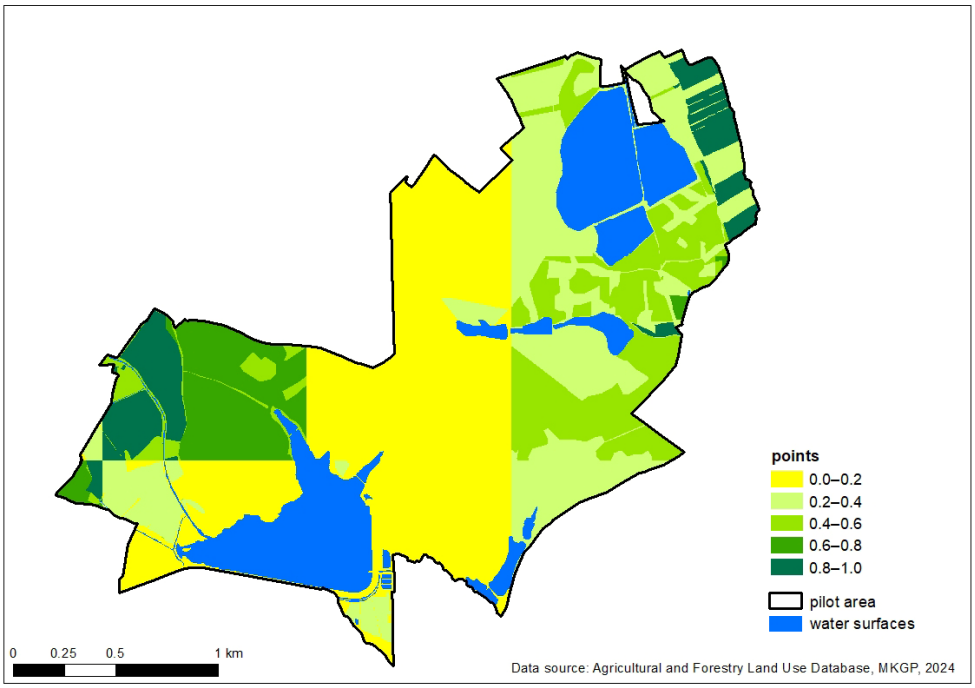

Figure 7. Provisioning ESs in the Rački ribniki–Požeg pilot area (points indicate index values 0–100).

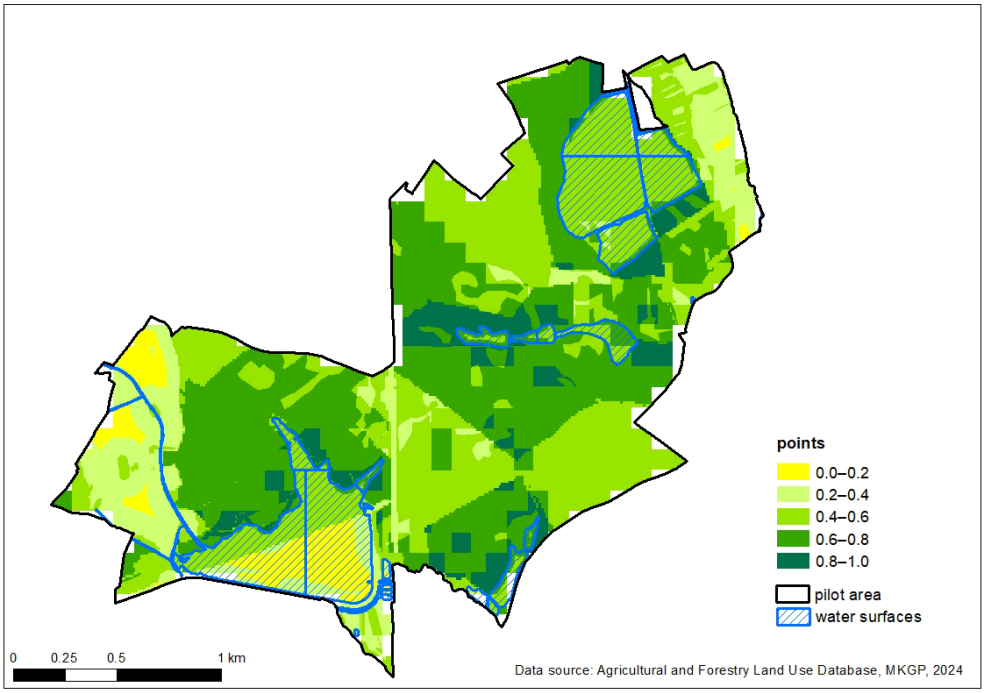

Figure 8. Regulating ESs in the Rački ribniki–Požeg pilot area (points indicate index values 0–100).

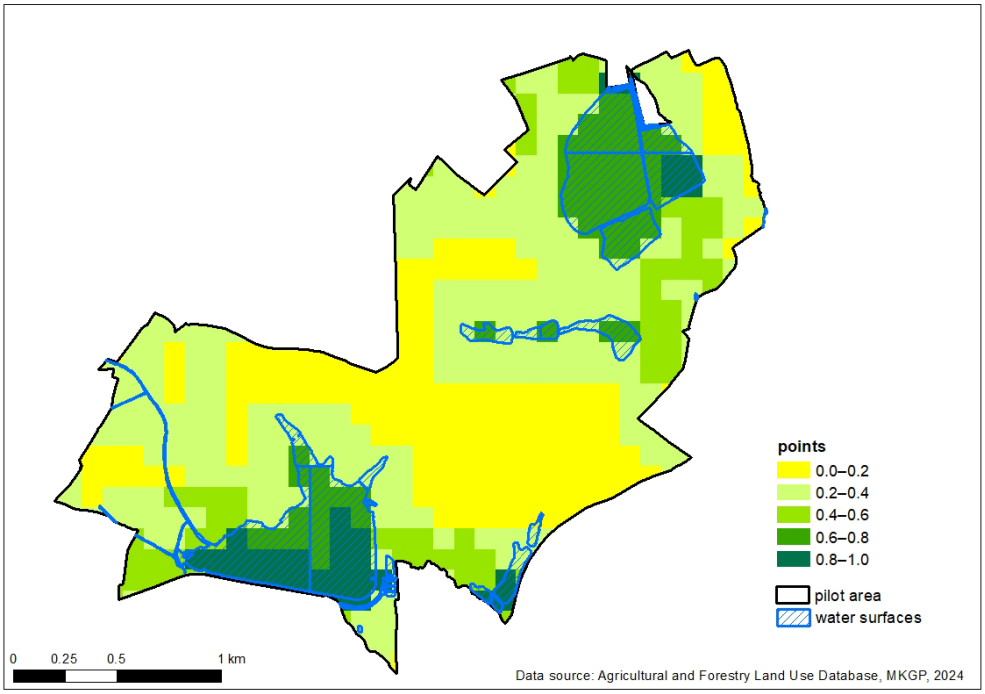

Figure 9. Cultural ESs in the Rački ribniki–Požeg pilot area (points indicate index values 0–100).

Regulating ESs are concentrated in several locations, without a clearly distinguishable spatial pattern of higher or lower concentrations. Nevertheless, areas near water bodies stand out as key contributors—particularly to ESs such as local climate regulation and the maintenance of habitats and populations (Figure 8).

Cultural ecosystem services are concentrated mainly in the area of water bodies (Figure 9). These locations also have exceptionally high potential for the recreational and aesthetic functions of the landscape. Water bodies in the Rački ribniki–Požeg area are, therefore, of key importance, as also confirmed by the ES assessment.

Based on the locations with high concentrations of the three ES groups, proposals for management zones were defined where management could be adjusted accordingly. Encouragingly, areas with a high concentration of provisioning ESs mostly do not overlap with those of the other two groups (Figure 10). Regulating and cultural ESs are often easier to maintain in areas with lower potential for agricultural production, forestry, or hunting. In fact, the use of these ESs is often difficult to reconcile with flood protection habitat conservation.

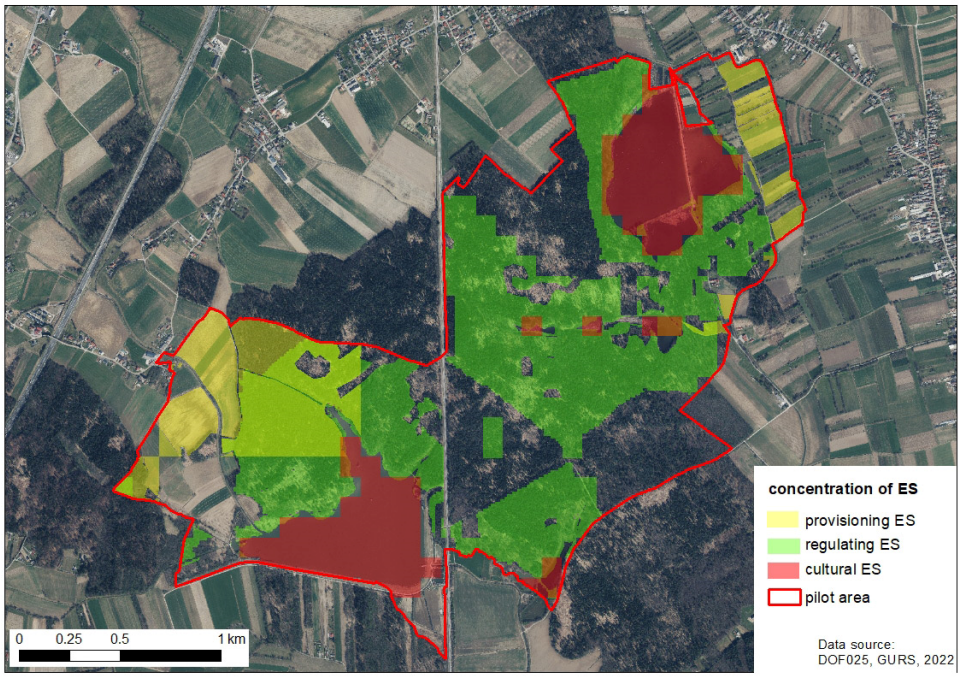

Figure 10. Areas with concentrations of provisioning, regulating, and cultural ESs in the Rački ribniki–Požeg pilot area.

The proposed management zones were overlaid with areas of first- and second-priority nature conservation (Figure 11). As defined in the baseline expert proposal for the park's protection [27], first-priority areas in the Rački ribniki–Požeg include all water surfaces, parts of forested area, and encroached wetlands and are defined as zones where the preservation of natural habitat characteristics is essential for species survival. From the management perspective, they serve as a basis for the immediate implementation of conservation measures, such as habitat restoration. Second-priority zones include forested areas that are important for maintaining habitat structure, enhancing or preserving other ecologically important areas, such as migrating corridors, and providing a buffer against various threats. The proposed management zones do not fully coincide with the conservation priority areas, as high availability of provisioning ESs also occurs within some second-priority conservation zones. Most provisioning ESs are found in forests, with smaller shares in arable land and meadows. This would imply that wood production (in forests) and crop growing (arable land) need to be within the scope of nature conservation priorities. The majority of regulating ESs, meanwhile, are located within first-priority conservation areas. The highest ranking regulating ESs according to stakeholders—flood protection, conservation of habitat and populations, wind protection, and local climate regulation—rely mostly on maintaining vegetation cover with varying vertical structure and substantial amounts of dead wood, which fits the conservation goals stated earlier [27]. Availability of cultural ESs is mostly related to the presence of water surfaces that stretch into first-priority areas.

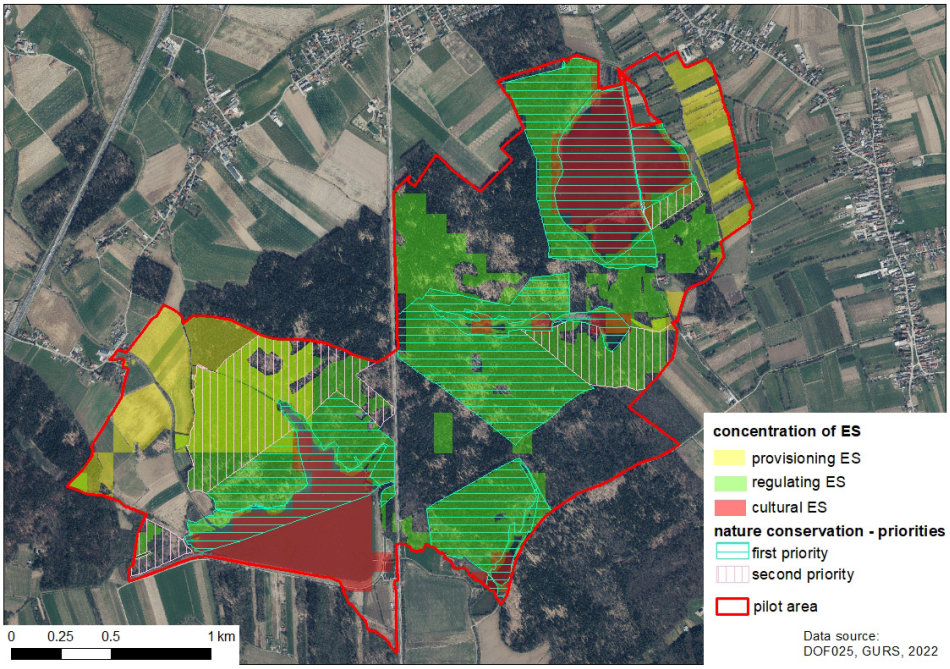

Figure 11. Areas with concentrations of provisioning, regulating, and cultural ESs overlaid with first- and second-priority nature conservation areas in the Rački ribniki–Požeg Landscape Park.

Within the individual management zones, the planning and implementation of management measures, therefore, need to be adapted to the dominant ES in each area. In doing so, it is advisable to apply a comprehensive assessment of the impacts of management actions on ESs, as outlined for the Rački ribniki–Požeg area in the section on conservation measures. Measures likely to have a strongly negative effect on a specific ES or group of ESs should be avoided. This approach ensures the integrity of ESs, helping to maintain or even enhance them, which is one of the fundamental objectives of the Norwegian Financial Mechanism program.

4. Discussion

This study provides a comprehensive examination of the concept of the ecosystem-based governance model (EBGM), which represents one of the tools for effective and transparent management of protected areas. The design of the model aligns with the goal of strengthening the capacity of managers to achieve sustainable ecosystem governance in protected areas, particularly in the context of expected climate change. Protected areas are distinctive in several respects—both in terms of management and ecological conditions—and, therefore, require a specific management regime. Such regimes often impose additional restrictions on agriculture, forestry, and infrastructure development, which in turn frequently give rise to conflicts that demand greater coordination and the search for joint, broadly acceptable solutions. Managing protected areas is thus a complex task, as diverse interests must be reconciled with the carrying capacity of sensitive and often rare ecosystems. When the effects of climate change are taken into account, the challenges faced by managers become even greater. This is also true for protected areas in Slovenia, which include habitat groups and habitat types within the Natura 2000 network, many of which are currently in an unfavorable conservation status [33]. At the same time, various ongoing activities in these areas may further exacerbate their condition. For these reasons, we developed and tested the EBGM in the Rački ribniki–Požeg Landscape Park as an effort to design an innovative governance approach for protected areas.

4.1. Elements of the EBGM Approach

The EBGM developed in this study addresses the challenges of effective and transparent ecosystem management by encompassing three essential aspects of governance: joint decision-making, the search for shared solutions to conflicts, and the effective allocation of management resources. The model was designed around several key components: the fundamental principles of natural resource governance models, their integration into the practical phases of the EBGM, and multiple evaluations of the model design with ZAGON project partners, stakeholders, and potential end users. The final version of the EBGM consists of six elements, which also represent interrelated phases of the process.

Defining the context is the first element of the EBGM and is particularly important for identifying the current challenges faced by managers and other stakeholders, such as local residents, non-governmental organizations, and sectoral services (forestry, agriculture, urban development, etc.). This step establishes the initial conditions in which key development problems must be identified through stakeholder engagement. It also involves formulating a shared goal for future management and defining measures that are flexible, inclusive, and aimed at strengthening ecosystem resilience [34,35]. Stakeholder participation is essential at this stage, which is why the EBGM includes a separate phase dedicated to identifying and selecting stakeholders. The main objective is to ensure that all key individuals or stakeholder groups are represented. This allows for consideration of their perspectives, interests, management capacities, and levels of influence in setting objectives and implementing measures. Such an approach promotes broad acceptance of the management action plan, reduces the potential for conflict, and strengthens the legitimacy of the EBGM [36–38].

The participatory selection of relevant ESs, carried out as part of the **ES review and prioritization** phase, represents the first direct interaction between the EBGM and various stakeholders. It enables an in-depth understanding of the relationships between local stakeholders and the environment. Mosleh et al. [39] argue that integrating stakeholder perceptions into management is a crucial link connecting diverse groups and their interests, while also fostering shared learning about traditional management practices, the socio-economic role of natural resources, and mutual relationships. For this reason, the assessment of past and future ES trends and the evaluation of stakeholder influence on ES availability were defined as a separate EBGM element—**defining the status, trends, and trade-offs**. This part of the EBGM was tested in a participatory manner at the pilot site, allowing for a deeper understanding of stakeholder perspectives and thus a more comprehensive grasp of the current management context, as also emphasized by Karrasch et al. [40]. During discussions on the effects of past management on current ES availability, participants jointly identified and spatially defined key conflicts. Although addressing conflict situations can initially create tension, it ultimately—as Friedrich et al. [41] note—facilitates the search for balanced solutions. In the EBGM, this step is established as a distinct phase, linking past actions of individuals or groups, their influence on ESs, and the resulting conflicts.

Considering the institutional and cultural context shifts the discussion to a broader spatial and systemic level, where—together with stakeholders and based on additional information—the key roles of relevant organizations, groups, and individuals are defined in terms of their rights and responsibilities. Effective management largely depends on a transparent and clearly defined division of roles [42]. Legislation provides the framework that generally determines the roles of different stakeholders, and its absence or ambiguity is often reflected in conflict situations, where unclear authority limits the capacity to address management challenges. In the case of the Rački ribniki–Požeg Landscape Park, stakeholders identified the absence of a dedicated manager in recent years as one of the

main weaknesses of previous management, since no organization was responsible for implementing essential management activities. Consequently, certain parts of the park are in a relatively disordered state, and individual actors have acted independently—altering infrastructure, neglecting embankments, engaging in unregulated freshwater fish farming, and contributing to uncontrolled visitation. At the same time, testing the EBGM also served as an attempt to provide expert foundations for revising the park's protection act. This process revealed several key conflicts among land uses, including unregulated recreation and tourism, nature conservation and biodiversity preservation (due to the unfavorable condition of habitats and habitat types), forestry (declining vitality of pedunculate oak populations), and agriculture (interest in expanding farmland within the park).

The EBGM developed in this study can serve as part of the solution for improving the current management of the Rački ribniki–Požeg Landscape Park and **provides a framework for improving the decision-making process** regarding its future governance. In addition to the participatory management process, which is primarily addressed in the first three elements of the EBGM, the model also introduces an innovative zoning approach for the park. Based on the assessment and mapping of selected ESs, we identified areas where three categories of ESs—provisioning, regulating, and cultural—are concentrated, which form the management zones. Within these zones, management should be adapted to the higher ES availability so that these services are not threatened and may even be enhanced [43–45]. In this sense, the EBGM represents an opportunity for a new approach to managing protected areas, as it enables the identification of zones with high ES availability that share similar management requirements, regardless of existing protection regimes. For the Rački ribniki–Požeg Landscape Park, we found that areas with concentrations of provisioning ESs do not spatially overlap with those where regulating and cultural ESs are predominant. This is favorable, as regulating and cultural ESs typically coexist in synergy, which is usually not the case when provisioning ESs are present in the same area. However, when management priorities focus primarily on regulating and cultural ESs, the sustainability of provisioning ESs can be jeopardized [46,47]. There might also be a conflict between cultural and regulating ESs, as we highlight in the case of a strong focus on ES recreation and leisure in a part of the pilot area, which can pose a challenge from a nature protection perspective. Our management recommendation would be to limit those activities to the southern part of the larger pond in the SW section of the park, which is outside the priority area. In this way, the EBGM provides direct guidance for managing protected areas while also contributing indirectly to policy development.

The first three elements of the EBGM focus primarily on data collection and interpretation related to the current situation. Since this is embedded in the context of past management and stakeholder actions, it also enables a comprehensive assessment of causal relationships between past factors and the present state. On this basis, the EBGM defines measures to strengthen ESs and mitigate conflict situations—one of its key contributions to natural resource management policy development. The EBGM is, therefore, not only a management tool but also a valuable source of information for policymakers.

In this study, we designed and tested an EBGM; however, during the duration of the ZAGON project, the model had not yet been implemented by the Rački ribniki–Požeg Landscape Park manager. Nevertheless, we prepared a manual for the application of the EBGM [48], which provides an overview and justification of its individual elements and enables the preparation and **implementation of proposed changes** to management in various contexts. The model's structure is sufficiently flexible to be applied not only in the management of protected areas but also in forest planning [49], urban development planning [50], agricultural policy implementation [51], and the organization of the tourism and recreation sector [52]. All these sectors depend heavily on the availability and vulnerability

of natural resources, and the challenges of their management can be effectively addressed through the participatory consideration of ESs.

4.2. Innovation of the EBGM Approach

The innovation of the EBGM arises from several defining characteristics. One of its key strengths is its broad applicability across different sectors, as discussed above. Another important feature is the participatory co-creation process through which the EBGM was both developed and tested. This ensures that the outcome of the research is not merely a theoretical contribution to the field but also a practical and implementable solution. Because the stakeholder group included actors with significant decision-making power—such as the Municipality of Rače, which will play a central role in future management—the feasibility of the EBGM was also partially evaluated. The model's design provides ample space for incorporating the views, perceptions, and concerns of diverse stakeholders while simultaneously enabling knowledge exchange between groups. This would play a role in the future organizational set-up of the park governance, in which the jurisdictions of individual stakeholders will derive from existing legislative frameworks. However, the EBGM outputs would support the designation of management regimes for different ecosystems, which could be based on the relative importance of ESs, stakeholder influence, and ES-based management zones.

4.3. Further Development of the EBGM Approach

Although the EBGM provides a comprehensive framework for participatory and adaptive management, there remain several opportunities for improvement. The assessment of past and future ES trends and the identification of influencing factors and actors were carried out using a simple ranking method. This approach could be enhanced by developing a more advanced evaluation system, allowing assessment of trends across different time periods, quantification of the relative influence (weight) of individual factors and actors on ES dynamics, and simultaneous evaluation of the reliability of future projections.

Another area for refinement concerns the mapping of management zones, which was based on the summed availability of selected ESs within the three main ES categories—provisioning, regulating, and cultural. The ES availability indicators were normalized on a 0–1 scale, as were the aggregated values of multiple ESs. This procedure could be improved by integrating data on importance or vulnerability—depending on the management context—through the application of weighting factors for individual ESs, thereby distinguishing their relative significance. Further improvements could also be achieved in the identification of ES concentration areas. Instead of defining these zones solely based on summed ES availability values, spatial clustering techniques could be applied. In this regard, it would be useful to test Moran's I statistic and related spatial analysis tools, compare outcomes, and validate the results with local stakeholders.

Additionally, the EBGM might be extended by integrating an additional module that would enable piloting alternative organizational structures of governance. Hypothetically shifting roles among existing stakeholders and even introducing new ones would enable simple simulations of different systems of responsibilities and rights.

4.4. Transferability of the EBGM Approach

The EBGM developed in this study represents one of the key outcomes of our case study, but its relevance extends beyond the project's specific context. It has the potential to become a recognizable framework for broader ecosystem management, as its design is not directly confined by a legislative framework. As a result, it remains general enough—and thus flexible enough—to be used in different contexts. One of the objectives of the Norwegian Financial Mechanism program, under which our research was funded, was to design

an innovative ecosystem management model that would ensure the continued availability of ESs, even under changing climate conditions—an issue that clearly transcends national boundaries. The EBGM approach could also be applied within other European initiatives, such as Nature Credits [53], where it will be essential to clearly define the ES to be enhanced, identify stakeholders who will act as both beneficiaries and implementers (e.g., landowners), delineate areas where actions would be most effective, and establish appropriate implementation and monitoring methods. In this sense, the EBGM could also contribute to the design of payment schemes aimed at strengthening ESs [54], as its structure enables the integration of all key phases of design, implementation, and monitoring.

5. Conclusions

This study presents the EBGM as an innovative framework for managing protected areas under increasing ecological and climatic pressures. Designed to enhance transparency, adaptability, and stakeholder engagement, the EBGM offers a structured approach to ecosystem governance that integrates scientific data with participatory decision-making.

The model contributes significantly to ecosystem management by identifying causal links between past actions and current ES conditions, enabling targeted interventions and supporting the development of natural resource policies. Its test application in the Rački ribniki–Požeg Landscape Park demonstrates how such a framework can reconcile conservation objectives with competing land use interests.

A central strength of the EBGM lies in its participatory foundation. By involving stakeholders throughout the process—from context definition to ES prioritization and conflict mapping—the model fosters legitimacy, reduces conflict potential, and promotes shared ownership of management outcomes. The inclusion of key decision-makers, such as municipal authorities, further enhances its feasibility and relevance.

The integration of ESs into governance is another core innovation of the EBGM. Through participatory assessment and spatial mapping of provisioning, regulating, and cultural ESs, the model enables a nuanced understanding of socio-ecological dynamics. This, in turn, supports adaptive strategies that maintain or enhance ES availability, even under conditions of climate stress.

The EBGM also introduces a functional zoning approach based on ES concentrations rather than existing protection regimes. This allows for ecologically meaningful and flexible management, ensuring that areas with high ES value receive appropriate attention and protection.

Although developed within the context of a specific protected area, the EBGM is designed to be transferable across sectors such as forestry, agriculture, urban planning, and tourism. Its structure supports implementation in broader policy contexts, including EU initiatives such as Nature Credits and payment schemes for ES enhancement.

While the model offers a robust framework, future refinements could improve ES evaluation methods and spatial analysis techniques. Enhancing the precision of management zoning and incorporating weighted assessments would further strengthen its applicability and impact.

In summary, the EBGM represents a practical and scalable tool for ecosystem governance, capable of guiding both local management and broader policy development in response to ecological challenges and stakeholder needs.

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P.H.; writing—review and editing, A.J., A.F., A.K., A.M.P., K.P. and P.H.; visualization, A.J., A.F., A.K., A.M.P., K.P. and P.H.; supervision, A.J., A.F., A.K., A.M.P., K.P. and P.H.; project administration, A.J. and A.F.; funding acquisition, A.J. and A.F. All authors have read and agreed to the published version of the manuscript.

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