

About the Contribution of Forest and Aquatic Ecosystems within Protected Areas to the Sustainable Development of Local Communities

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Abstract: *The EU's vision for 2050 is to properly protect, enhance and restore biodiversity and ecosystem services provided by protected natural areas, considering the intrinsic value of biodiversity and the essential contribution of ecosystem services to human well-being and economic prosperity of the local community. Starting from this desideratum, through this paper we aimed to show that forest ecosystems, as well as aquatic ones, have an important role in the sustainable development of local communities if their contribution is properly assessed. We also want to emphasize that a 'beneficiary pays' policy is much better perceived and adopted among local communities, as opposed to a 'polluter pays' policy, moving from environmentally friendly to protective actions making it much easier.*

Keywords: *Biodiversity, community development, ecosystem services, natural heritage, sustainability.*

1. Introduction

Protected areas in Romania offer a wide range of ecosystem services, such as regulation and support services (water quality control, flood control, erosion control, regulation of nutrient and toxic substances content, maintaining biodiversity), cultural services (leisure activities, tourism, provision of aesthetic, educational and scientific resources), as well as production services (wood resources, non-wood resources, drinking water resources) [1,2]. They can be particularly important for local economic development, thus helping to attract investment funds and providing an important direct or indirect source of employment, both locally and regionally.

This paper aims to present some of the benefits of two groups of ecosystem services in a protected area in Romania - Maramureș Mountains Natural Park (MMNP), as well as the mechanisms that can support their provision. The results of the studies can be replicated nationally and internationally and used to raise awareness among decision-makers about the importance of protected areas for the economy and well-being of local communities.

2. Methodology

The documentation for this paper was based on the authors' concerns for ecological education and environmental protection [3,4], and the idea that a community can only develop harmoniously through care for protected areas and the biodiversity that populates them [5,6]. With a range of highly relevant studies at the national level, both in terms of protected area management [2,7-10] and some reports on the potential and benefits of forest and aquatic ecosystems, the authors decided to extrapolate the respective approaches on the relatively limited space of the protected natural areas, presenting as a case study the situation regarding the ecosystem in the Maramureș Mountains Natural Park.

3. Results and discussion

3.1 Ecosystems in protected natural areas and associated ecosystem services

Ecosystem services are flows of materials, energy, and information from natural capital stocks that combine with the services of manufactured and human capital to produce human well-being [1]. There are of course three perceptual perspectives on what ecosystem services involve, namely:

- processes by which the environment produces resources that are considered free by humans, such as clean water, timber, pollination, etc.
- the benefits that people get from nature.
- components of nature consumed or used directly to produce human well-being.

According to the literature [1,11], ecosystem services are divided, as follows, into the following categories, namely:

- production services are provided by the ability of ecosystems to provide various resources, such as food, wood, fuel, drinking water, etc.
- regulation and maintenance services are determined by the ability of ecosystems to control natural processes - regulation of climate, water quality and quantity, soil formation, control of diseases and pests, habitat maintenance, etc.
- cultural services result from physical, intellectual, spiritual, and symbolic interactions with the components of natural capital, in which case we discuss the aesthetic value of the landscape as a space for recreation.

In this sense, the provision of ecosystem services is achieved by combining natural capital with anthropogenic, but taking into account the Management Plan of protected areas, as well as the specific activities allowed in the three areas related to them, namely:

- Integral Protection Zone (IPZ) - human activities are prohibited, except for traditional grazing activities, research activities, education, and ecotourism;
- Buffer Zone or Sustainable Management Zone (SMZ) - which is the transition zone between the Integral Protection Zone and the Sustainable Development Zone;
- Sustainable Development Zone (SDZ) - which includes the built-up areas of the localities in the park, the areas occupied by permanent communication routes, mountain pastures outside the integral protection area, as well as areas outside the built-up areas of localities that have undergone anthropogenic changes.

3.2 Maramureş Mountains Natural Park from an ecosystem perspective

Maramureş Mountains Natural Park (MMNP) is a delimited territory in which the natural, historical, and cultural attributes are protected based on regulation, for conservation and sustainable development. The surface of the park is 133,621 ha. MMNP was declared a protected area of national interest in the category of natural parks (IUCN category V - Protected landscape: protected area managed mainly for landscape conservation and recreation) in 2005 [12-15]. It was created primarily for the conservation of the local landscape and traditions, for the protection of the zonal natural, spiritual and cultural heritage, for the sustainable management of forests and the encouragement of sustainable tourism based on these values [16]. Moreover, due to the presence of priority habitats and species, it was designated as a site NATURA 2000 - ROSCI0124 and ROSPA0131 Maramureş Mountains (see Fig. 1) [17,18].

The region is one of the richest biologically in the Northern Hemisphere, ensuring connectivity with Ukraine. In this area, there are species of wildlife such as lynx (*Lynx lynx*), wolf (*Canis lupus*), brown bear (*Ursus arctos*), European mink (*Mustela lutreola*), otter (*Lutra lutra*), as well as special species of mountain flora [12 13]. The main economic activity of the region is the exploitation of wood (with a very limited added value for the local economy), animal husbandry, and, not recently, tourism. The main tourist attractions are Mocănița - the steam train on the Vaser Valley, the traditional wooden architecture, the local traditions, and the special landscape. The local communities in the Maramureş Mountains Natural Park are located in the north and east, along the national road and rivers. There are two cities - Vișeu de Sus and Borșa, and 8 communes - Bistra, Leordina, Moisei, Petrova, Poienile de Sub Munte, Ruscova, Repedea, and Vișeu de Jos. The total population within MMNP being 87,580 inhabitants (according to the 2012 census).

Within the MMNP, several forest habitats (approx. 26) specific to the hill and mountain area were identified and mapped by specialists, including forest ecosystems of both beech and coniferous mixtures, as well as pure or even rare spruce. The forest vegetation covers approximately 65-68% of the PNMM area. Within the Natura 2000 habitats, the largest share in the area included in the habitat type - 9410 Acidophilous spruce forests (*Picea*) from the mountain floor to the alpine one (*Vaccinio-Piceetea*) which sums up several categories of forest habitats.

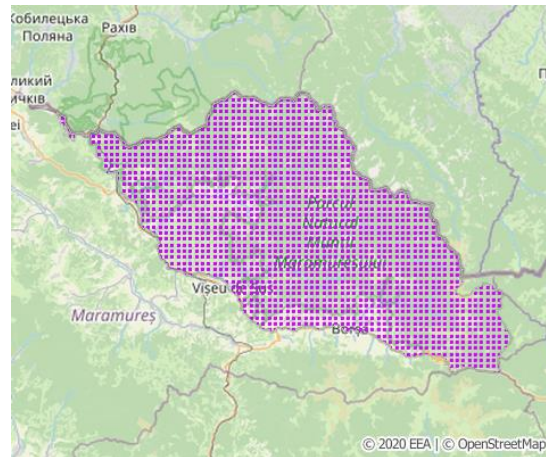


Fig. 1. Reference area of the Maramureș Mountains Natural Park [17]

The MMNP extends in the northern part of the Someș-Tisa hydrographic area. The hydrographic basins with the largest extension in the area of the protected natural area are Vaser, Vișeu, and Ruscova. approximately 3.8-4% of the total area of PNMM. At the level of PNMM, within the three specific areas of any protected natural area, respectively ZPI - 17,619.25 ha, ZMD - 75,975.90 ha and ZDD - 40,025.85 ha (see Fig. 2) [19], there are the following categories of aquatic ecosystems:

- plots (763.1 ha) - permanent and non-permanent watercourses;
- lentic (24.44 ha) - natural lakes and accumulations;
- wetlands (4,356.77 ha) - swamps.

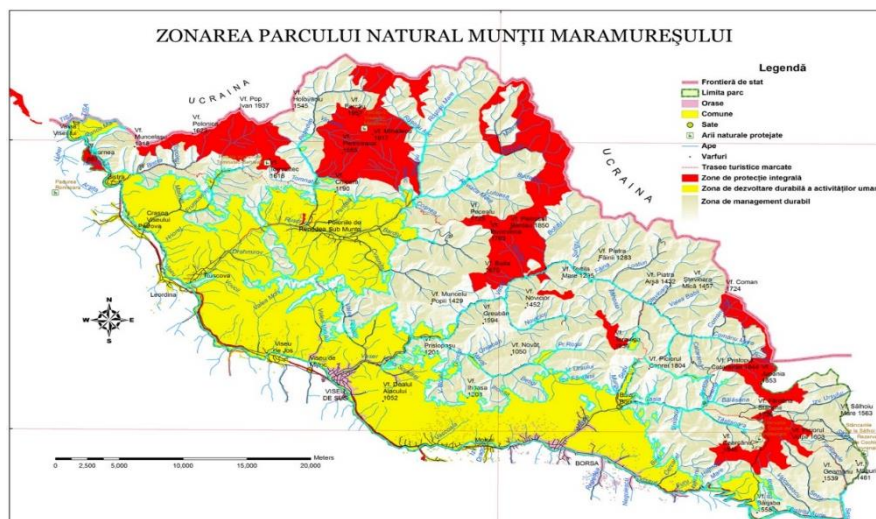


Fig. 2. Maramureș Mountains Natural Park zoning [19]

In the Maramureș Mountains, the continuity of the lotic systems is naturally interrupted sometimes by waterfalls of significant dimensions: Criva, Tomnatec, and Bardău. In the Vișeu basin, for example, water quality is influenced locally by mineral springs. The slow aquatic ecosystems in PNMM are less represented, for example, Lutoasa, Bârsănescu, Budescul Mare, Măgurii, Tăul Roșu, and Vinderel lakes. Representative wetlands are the Mejghi, Berescu swamps, the one on Vârtoful Mare, the one below Pietrosul Bardăului, etc.

3.3 Evaluation of the contribution of ecosystem services in the MMNP

Forest and aquatic ecosystems provide services, but they are not quantified and paid for at their true value, so their supply is guaranteed in the long run. Restrictions imposed by the management of protected years to ensure the conservation of natural ecosystems and the provision of ecosystem services are not properly assessed and, consequently, there is no chance of them being paid by the beneficiaries of the services generated.

The forestry sector, where about 50% of Romania's forests are privately owned, is underfunded and there are no subsidies or other means of support from the state budget or other funds to manage forests and maintain the role of protection. Besides, there are no compensation schemes for private forest owners in any protected natural area. This is one of the reasons why private owners are reluctant to support the implementation of management measures and very often resort to illegal practices. The assessment of the services provided by the forest ecosystems in the MMNP pilot area must take into account flood protection services, water supply services, soil erosion control, habitat establishment, and the provision of quiet areas specific to ecological transit corridors, provision of non-timber resources and ease of hunting activities. About the assessment of the services provided by aquatic ecosystems, this must include production services (water resources used for drinking and local economic activities, mineral water resources, etc.), regulation, and support services (flood control, biodiversity maintenance). and cultural services (the service of recreation and provision of aesthetic resources).

Table 1: Forest and aquatic ecosystem services and their beneficiaries

Beneficiaries of ecosystem services	Forest ecosystem services	Aquatic ecosystem services
Administrative-territorial units (ATU)	Flood protection Hydrological regularization Erosion control Aesthetic framework Non-wood resources Resources for pharmacology	Drinking water resource Mineral water resource Flood control Recreational resource (tourism)
Road infrastructure companies	Flood protection Erosion control against floods	Flood protection
Insurance companies	Flood protection	Flood protection
Energy sector	Hydrological regularization	Industrial water resource
Water bottling companies	Hydrological regularization	Drinking water resource Mineral water resource
Water dispensers	Hydrological regularization	Drinking water resource
Agricultural holdings	Flood protection Erosion control against floods	Industrial water resource Educational and scientific resource
Educational and research institutions	Educational and scientific resource	Educational and scientific resource
Tourism industry	Aesthetic framework Habitat and refuge	Drinking water resource Mineral water resource Fish resource Recreational resource (tourism)
Hunters' associations	Aesthetic framework Habitat and refuge Non-wood resources Genetic resources	Maintaining biodiversity Recreational resource (tourism)
Fish farms	-	Industrial water resource Fish resource
Non-timber products companies	Non-wood resources Genetic resources	-
Beekeepers	Habitat and refuge Non-wood resources Genetic resources	-
Pharmaceutical companies	Resources for pharmacology	Drinking water resource

In a participatory manner, a working methodology and a strategy on establishing and calculating compensations for forest owners with restrictions on timber harvesting were developed. Thus, it is desired that those forest owners with protection functions be compensated for the value of the services offered by the forest ecosystems, to maintain the protective functions of the forest. The methodology takes into account the loss of income of the owners, as well as the costs of active management for the forest areas restricted from felling. Similarly, we are working on a strategy that takes into account adequate pricing for the price of water that comes to serve users.

In the pilot area of PNMM, following the ranking of beneficiaries of ecosystem services for the two types of ecosystems according to Table 1, it can be seen that the administrative-territorial units prevail within the structure for forest ecosystem services for flood protection function, followed by hunting associations for the quiet area creation function. Among the aquatic ecosystems, the fish farms, together with the tourists and the administrative-territorial units benefit the most from the supply of the drinking water resource and for economic activities. For these categories of beneficiaries and not only should be followed the payment schemes (grants).

Park administrations (service provider) collect low revenues from visiting fees. The private sector (represented by tour operators, hotels, boarding houses, restaurants, transport companies, and souvenir manufacturers) is the main beneficiary of the ecosystem services provided by the protected area. The private sector is therefore the main stakeholder in getting involved in designing and adopting any possible payment mechanism for ecosystem services, thus keeping their productive potential (protected area) unaltered.

The lack of clear compensatory measures for landowners can also be an incentive for them to continue to use some of the resources (wood, stone, hay, etc.) in an unsustainable manner. This can lead to the degradation of ecosystems, which will negatively affect the supply of tourist services. Inadequate water management can also affect water quality and industry can affect air quality, while uncontrolled infrastructure development can lead to the loss of architectural styles so sought after by tourists.

Through this paper, we aimed to identify, describe, analyze and evaluate the services of forest and aquatic ecosystems in the MMNP ecosystem, by using for Romania the recommendations of the European Union, provided in the reports Mapping and Assessment of Ecosystem Services, on meeting the objectives of the EU Biodiversity Strategy.

The results obtained in the work in terms of identified ecosystem services are addressed to national and local public authorities and administrations, scientific communities, non-governmental organizations (NGOs), and the population. The final aim of the paper was to highlight the natural, scientific, recreational, and economic value of wetland ecosystems and the goods and services provided, as well as the role and importance of their sustainable management for biodiversity and socio-economic development of society.

4. Conclusions (and recommendations)

The evaluation of the services provided by the forest and aquatic ecosystems makes an important contribution to the estimation of the total economic value of the services in the area of the different protected areas. The identification, analysis, and valorization of the services provided by each category of the ecosystem cannot be always feasible, because, for certain categories of services, such as cultural ones, the analysis and valorization is performed at the level of the ecosystem complex, and not on each component unit in part. At the same time, economic evaluation (in other words monetary quantification) makes sense from the perspective of quantifying the value of nature to support human activities (the beneficiary principle pays), as well as quantifying the impact of these activities on ecosystems (the polluter pays principle).

In the sense of the above, there are at least two directions for promoting ecosystem services. On the one hand, we are talking about the compensations grant for ecosystem goods and services, and on the other hand, we are talking about the granting of incentive payments (as subsidies) for adopting a behavior that prevents and protects ecosystems.

The "polluter pays" principle is not enough to secure the provision of environmental services in the long run. Therefore, an attempt is made to establish a fair value for environmental services, based on impact and benefits, by applying the "beneficiary pays" principle. To sustainably manage

ecosystems in a protected area, an approach that integrates three pillars is needed: legislation - capacity - funding, and in these conditions no legislative framework is useful and effective in the absence of adequate implementation capacity and funding.

The approach we propose is that of shifting from a status of violation of the rules on the protection of ecosystems (forestry and/or aquatic) to a status of stimulating/rewarding practices that ensure the maintenance/restoration of their status. We believe that this forms a package of measures on ecosystem regulation (appropriate legislation), a form of administration and governance, and options for financing payment schemes. Under these conditions, the payments do not serve strictly restrictions or a certain status of ecosystems, but the shift of the behavior of landowners and/or users from actions damaging to natural ecosystems (negative impact) to behavior that sustainably integrates ecological systems. with the socio-economic ones (positive impact).

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