ECOLOGIA BALKANICA

2025, Vol. 17, Issue 2 December 2025 pp. 035-039

Assessment of some ecosystem services in the region of Rhodope Mountain, Bulgaria

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Abstract. Human society directly depends on a number of natural products and services such as plant and animal resources, mushrooms and herbs, wood and aggregates, water for drinking and non-drinking purposes, fuels and others. For these reasons, in the last decade, intensive work has been done to deepen understanding of human dependence on natural processes at different temporal and spatial scales, as well as to search for appropriate economic and management criteria and indicators by which to measure the value of these ecosystem services. All of the above mentioned determines the relevance of the current study, related to the analysis of ecosystem services on the territory of two villages, situated into the region of the Rhodope Mountain - Brestnik and Belashtitsa, as a resource for social and ecological development. A total of 22 ecosystem services were identified, of which material ecosystem services include 9 classes, regulating and supporting services - 7 classes, and cultural services - 6 classes. These ecosystem benefits are an object of consumption and a resource for social and ecological development not only for local residents and agricultural producers, but also for visitors to the study area, which highlights their exceptional intrinsic value and the need for their conservation and sustainable use.

Key words: natural resources, benefits, traditional food, cultural habits.

Introduction

By its nature, the concept of ecosystem services is interdisciplinary, integrating ecology and economics, since ecosystems are life-supporting systems that provide ecosystem services and economic benefits. Some authors also consider them as functions and processes through which natural ecosystems and their components ensure their existence (de Groot et al., 2002). Thus, they preserve their biological diversity, while at the same time realizing their biological productivity (Brundtland Report, 1987).

A key point of the concept of ecosystem services is the inextricable link between humans and nature, as it integrates ecological, social and economic principles (Nikolov, 2018). Human society directly depends on a number of natural products and services such as plant and animal resources, mushrooms and herbs, wood and aggregates, water for drinking and non-drinking purposes, fuels and others. This has led to the main problems in ecosystems, namely excessive use of resources, both water and biological, as well as industrial, domestic, agricultural and other

pollution, etc. In addition, people also consume many indirect services from ecosystems, including purification of air, water and soil from pollutants, climate regulation in a global, regional and local aspect, maintenance of soil fertility, etc. The majority of benefits from the group of cultural ecosystem services (for example, leisure and recreation, aesthetic interactions, traditions and rituals) are also intangible and therefore often remain undervalued by society. For these reasons, in the last decade, intensive work has been done to deepen understanding of human dependence on natural processes at different temporal and spatial scales, as well as to search for appropriate economic and management criteria and indicators by which to measure the value of these ecosystem services.

All of the above mentioned determines the relevance of the current study, related to the analysis of ecosystem services on the territory of two villages, situated into the region of the Rhodope Mountain - Brestnik and Belashtitsa, as a resource for social and ecological development. So far, no such studies have been carried out in this region, nor has the potential of ecosystems to provide such benefits for people and nature been assessed.

Materials and methods

The methodology applied is based on the second MAES report (2014) which proposed a three-leveled approach to the assessment of ecosystem services, taking into account the availability of data and the specificities of the specific services. The formulation of the three tiers is as follows: Level 1 - expert assessment based on freely available land cover data; Level 2 - assessment based on quantitative data from statistical information, field measurements and simple spatial models; Level 3 - assessment based on results from specialized models operating at different spatial and temporal scales (Potschin et al., 2016; www.inesproject.com). Level 1 is applicable to all ecosystem services relevant to urban ecosystems. Experts, according to their expert judgment, should assess the potential of each ecosystem subtype to provide ecosystem services. Level 2 is applicable to ecosystem services that have indicators supported by quantitative data. In this case, experts must develop an assessment approach based on quantitative data for each individual class of services and, accordingly, an approach to bring the assessment to the single scale from 1 to 5. Level 3 is applicable to ecosystem services that can be modeled using detailed data and in-depth analyses.

In order to obtain the necessary information for the assessment of cultural ecosystem services, an original questionnaire for a sociological survey was developed in electronic format and as a printable version (Petrova et al., 2025). The layout of the questionnaires followed the standard requirements for structuring - an introductory part (to whom the survey is addressed, who is conducting the survey and for what purpose), instructions for filling in, data about the respondent (gender, age) and the main part, which contains the main questions, arranged in a certain system and subordinated to the purpose of the study. The survey method is widely used for scientific research purposes and in quantitative research, as it allows for the collection of rich information about the studied phenomena, processes, individuals, etc. (Stoyanova, 2021).

The survey was conducted in the period 2023-2024, with participation being voluntary for the participants (respondent principle) and anonymous. Some of the questionnaires were completed in paper form, while others were generated as electronic forms in Google Forms in order to reach a wider range of respondents.

The results of the survey were subjected to mathematical and statistical processing using the SPSS software package for Windows, version 22 (IBM Corporation), at a significance level of $p<0.05$ (Slavova & Slavchev, 2015).

Results and Discussion

The assessment of the capacity of ecosystems in the study area to provide ecosystem services includes not only quantitative but also qualitative indicators, including feedback from the users of these services (local population, tourists, etc.). It is they who allow a more complete assessment of the importance and role of ecosystems, as well as their capacity to provide ecosystem services.

To the question "Do you grow any crops or farm animals?" the majority of respondents answered negatively – 56% from the village of Brestnik and 66% from the village of Belashtitsa. 25% of the residents of both settlements indicated

that they grow such crops, but only for their own consumption, and the rest – for their own consumption and for sale (19% in the village of Brestnik and 9% in the village of Belashtitsa).

Among the crops grown in the village of Brestnik, cherries (27%), tomatoes (17%), vineyards (13%), potatoes (13%) predominate, and plums, apples, strawberries, cucumbers, onions, etc. are less common. The animals grown are chickens (4%) and bees (4%). In the village of Belashtitsa, the predominant crops grown are cherries (19%), tomatoes (17%), strawberries (13%), plums (11%), onions and garlic (11%), and potatoes, thyme, apples, apricots, figs, etc. are less common.

Slightly more than half of the surveyed local residents consume material goods from the natural ecosystems in the area of the settlement, of which herbs (15% from the village of Brestnik and 23% from the village of Belashtitsa), mushrooms (2% from the village of Brestnik and 6% from the village of Belashtitsa), firewood (11% from the village of Brestnik and 9% from the village of Belashtitsa), berries (4% from the village of Brestnik and 4% from the village of Belashtitsa), game/fish (only 11% from the village of Brestnik).

To the question "Have you noticed any changes in land use and land management in your region in recent years?" the interviewed farmers answered unanimously that agriculture in the region is intensifying, which is associated with increasing pressure on ecosystems due to the introduction of ever-increasing amounts of mineral fertilizers and chemical plant protection products. This process is accompanied by increased urbanization and industrialization, also leading to increased anthropogenic pressure (50%) (Fig. 1). The consequences of these negative impacts are already visible as soil degradation processes, reduced fertility, erosion, etc. (50%). A significant problem is the abandonment of agricultural land, which was indicated by 75% of respondents. The pressure from climate change, both on agriculture and on natural ecosystems, is also unanimously indicated. Possible compensatory measures to mitigate such negative impacts are not applied at all or are poorly implemented – protection through inclusion in NATURA 2000 protected areas, afforestation, drip irrigation systems, organic production, etc.

To the question "Have you noticed any of the above socio-economic changes in your area in recent years?" they answered unanimously that the pressure of market influence on agricultural production decisions has increased greatly, which is why one of them believes it is likely that he will soon give up and sell the land, and another says that he cannot be sure about his plans for the future either. The remaining two have stated that they will continue to engage in agriculture, with one having plans to expand the volume and increase the assortment of crops grown. With regard to the subsidies granted for growing a given crop, half believe that there are still no clearly defined rules of order and this creates additional pressure on the agricultural sector. One of the respondents indicated that there is a trend to promote environmentally friendly practices in the area, but this was not confirmed by the others. Regarding the influence of the tourism sector, opinions are mixed - 50% define it as weak, 25% - as medium and another 25% - as high (Fig. 2).

When asked "How satisfied are you with the natural resources in the area of your settlement?", the responses highlighted the high appreciation of people for the forest (59% village of Brestnik, 74% village of Belashtitsa) and herbaceous (44% village of Brestnik, 45% village of Belashtitsa) ecosystems around the two settlements. The resources of wild plants (37% village of Brestnik, 47% village of Belashtitsa) and wild animals (40% village of Brestnik, 53% village of Belashtitsa) are also highly appreciated, as is the aesthetic enjoyment of unique and beautiful rocks/landscapes (29% village of Brestnik, 38% village of Belashtitsa).

Regarding the ecosystem services provided by the ecosystems in the area, the respondents unanimously indicated their use for hunting and fishing, as a place for recreation, but also for preserving the historical and religious memory of the region. They provide an abundance of beautiful landscapes (100%), which are associated with some of the annual celebrations, gatherings and festivals (50%). They, in turn, strengthen the sense of tribal identity (75%) and serve to transmit the heritage of knowledge, values and beliefs to the next generation (100%). Agricultural production in the region is linked to family or religious traditions (75%) - a source of knowledge about cultivating the land and producing food (75%), which in turn contributes to the preservation of traditional rural lifestyles and agricultural practices (75%).

Taking care of the environment helps to build a closer connection with nature (50%), to emotionally and physically recharge (50%), and inspires artistic creativity (50%).

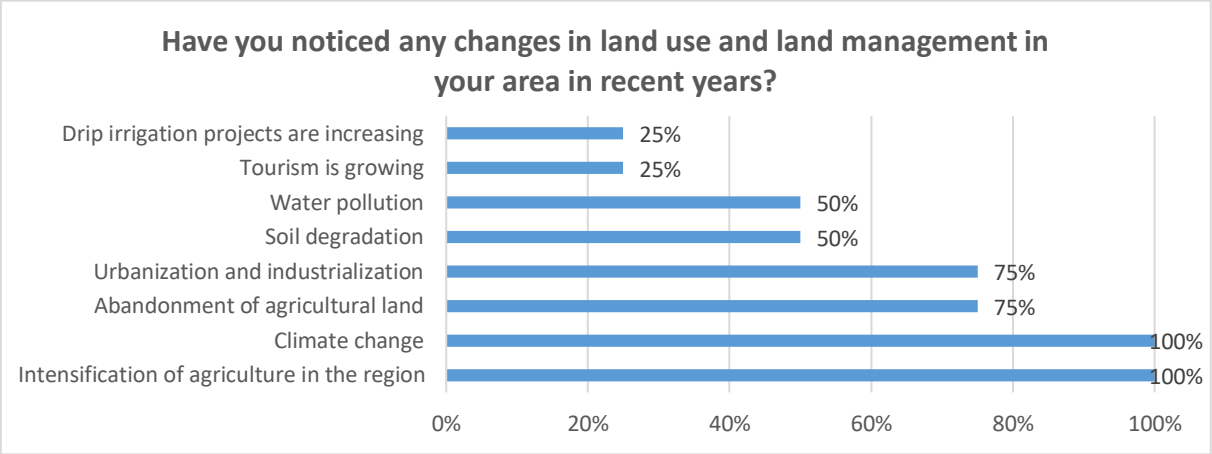

Fig. 1. Results from the conducted survey in Brestnik and Belasthitsa – answers of the question "Have you noticed any changes in land use and land management in your area in recent years?".

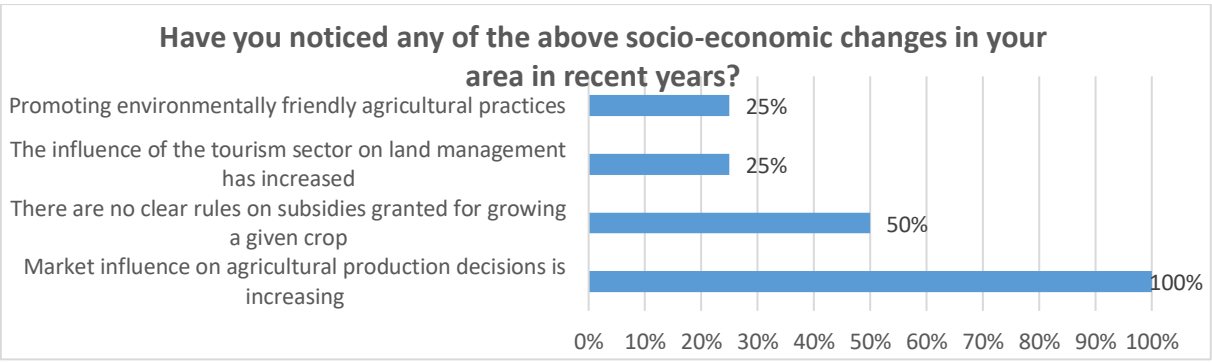

Fig. 2. Results from the conducted survey in Brestnik and Belasthitsa – answers of the question "Have you noticed any of the above socio-economic changes in your area in recent years?".

Based on the conducted studies, observations, surveys and analyses, a total of 22 ecosystem services provided by ecosystems in the areas of the two settlements of the Rhodope Mountain have been identified, as follows:

1) ***Material Services*** – food, water, biomass, materials

P1. Food products from agricultural crops

P2. Food products from livestock farming

P3. Forest fruits, herbs, algae and other wild plants

P4. Wild animals and their production

P8. Groundwater for drinking purposes

P9. Surface non-potable water

P11. Groundwater for non-potable purposes

P12. Natural materials for direct use, agricultural use or processing

P13. Genetic from biota

2) ***Regulating And Supporting Services*** - regulation of waste, toxic waste and other harmful substances

R3. Regulation of pollution and other impacts

R8. Regulation of water flows and protection from floods

R10. Regulation of air flows and atmospheric risks

3) ***Regulating And Supporting Services*** - maintenance of physical, chemical, biological conditions

R12. Pollination and seed dispersal

R16. Regulation of soil formation and soil composition

R20. Climate regulation at the global level

R21. Climate regulation at the national level

4) ***Cultural Services*** - physical, intellectual, spiritual, etc.

C1. Recreation (experiencing a connection with the environment)

C3. Scientific and educational value (conducting scientific and educational programs)

C5. Historical and cultural heritage

C6. Entertainment and recreation

C7. Aesthetic and spiritual value

C10. Sense of conservation of natural heritage

These ecosystem benefits are an object of consumption and a resource for social and ecological development not only for local residents and agricultural producers, but also for visitors to the area, which highlights their exceptional intrinsic value and the need for their conservation and sustainable use.

Conclusions

The studied area of the Rhodope Neck is distinguished by a high richness and diversity of natural resources, which provide material and intangible benefits not only for the local community, but are also highly valued and sought after by the tourism sector. A total of 22 ecosystem services were identified, of which material ecosystem services include 9 classes, regulating and supporting services - 7 classes, and cultural services - 6 classes. Both locals and visitors highly appreciated the forest and grassland ecosystems, their wealth of wild plant and animal species, unique rock formations and landscapes. Natural ecosystems are an environment for various social activities and interactions, both in family and friendship. Most often they are related to the search for opportunities for relaxation and recreation, sports and tourist attractions.

Acknowledgments

The study is funded by the project FP23-FiF-004 "Cultural Heritage as a Resource for Social and Ecological Development" at the University of Plovdiv "Paisii Hilendarski".

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Received: 18.20.2024
Accepted: 23.09.2025