



UDC: 630*2:574.4

Review paper

The Possibilities for Improvement of Ecosystem Services in Tara National Park

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Abstract: During recent years, ecosystem services have been put in the focus of research interest on global level. The importance of this subject is recognized in multiple scientific fields so the main goal of conducted research is assessment, valuation and implementation of these services. Most of the research considering forest ecosystem services is focused towards finding the solution for current and future climate change, and definition and assessment of other forest ecosystem services that have positive impact on environment, but also on humans. Recent medical research showed positive effects of forests on human health; spending time in forests resulted with blood pressure decrement, stress reduction and the increment of lymphocytes that reduce the amount of cancer cells. Amount of funds that are globally used on medicaments for symptom reduction of chronic diseases in terms of cardiovascular, pulmonary and mental illnesses, evidently show a huge impact of this subject on the economy. This paper describes the connection between forests and human health in the terms of forest ecosystem services and provides an assessment for future research and implementation of forest health paths in the Tara National Park. Establishment of forest health path will open new opportunities for further research where influence of different tree species will be assessed and effects of different genotypes on human health will be enlisted.

Keywords: Ecosystem services, forest, health, Tara National Park, forest health path.

1. Introduction

The only constant characteristic of human population through the years of development is its dependence on nature. Since the beginning of its existence a human relies on environmental resources such as clean water, nutrient cycle and food. Nowadays, all of the services that humans benefit from nature are called ecosystem services. According to Boyd and Banzhaf (2007) ecosystem services can be defined as components of nature, directly enjoyed, consumed, or used to improve human well-being and quality of life. Ecosystem services, as an important factor of bioeconomy transform natural resources (plants, animals, soil, air and water) into the goods that we need, use and value. First great attention to this subject has been given with the publication of Millennium Ecosystem Assessment in 2005, which provided cutting-edge state of trends

considering ecosystem services worldwide. Recent study published by The Economics of Ecosystems and Biodiversity (TEEB, 2010) drew a lot of attention by underlying to the importance of defining the economic values of this environmental subject. TEEBs main objectives are to mainstream the values of ecosystem services and biodiversity by valuation of its benefits, and to make an impact on decision-makers in order to acknowledge the importance of ecosystems. Now, there are clear evidence that many human dominated ecosystems, at regional and global levels, have become highly stressed and dysfunctional (Rapport et al. 1998). Repeated overexploitation of economic species, loss of biological diversity, and degradation of regional environments now call into question the economic ideas and values that have set the pillars for management of natural resources (Regier et al. 1996). These stressed ecosystems, still very important for human health and well-being are becoming highly degraded, and incapable of supplying services as in the past. Current assessment for future conditions of ecosystems is not optimistic in general, and it is considered that its capacity to ensure resources cannot cope with high demands of rising industry. With the continuous devastation of natural resources, human health and biodiversity is going to be even more endangered. These changes are predominantly affecting forests and its survival worldwide. According to Orlović et al. (2012) humans directly threaten forests with the rise of agriculture production by converting forests into agricultural fields. Furthermore, forests are also threatened by numerous biotic and abiotic factors such as air and water pollution, insect and disease infestations that are specific for ongoing climate changes. Considering ecosystem services, forests have an important role in the economy, biological diversity, the global carbon cycle and water balance (Orlović et al. 2005), but also have a great influence on society in the terms of environmental safety, recreational services and health, rural development and jobs, in that way directly affecting local communities. Currently, forests cover approximately 31% of the total land area worldwide, and through its functions they support the provision of ecosystem services in terms of direct and indirect contributions to human well-being. According to Haefele et al. (2016) direct benefits derive from on-site use, whereas passive benefits are independent of on-site use. In both cases, survey data is needed for the calculation of “net economic values” —how much people are willing to pay in order to enjoy National Parks. While the current forestry practice still describes non-timber forest products as secondary, the concept of ecosystem services originating from FAO emphasizes the economic significance of non-timber products and services (Trudić et al. 2015). In recent years, dominantly medical research showed an important role of forests on human health through direct forest ecosystem services. Due to alarming health issues of human population and detrimental effects they have on society and economy, the role of nature in the terms of ecosystem services, as an unobtrusive method for improvement of health and quality of life should be defined and implemented as soon as possible (Zorić et al. 2018). Natural systems, especially forests have enormous potential for improvement of quality of life and general well-being of human population. The further research on forest ecosystem services benefits and human health could provide an important data for valuation of these ecosystem services. The valuation of ecosystem services plays an important role in biodiversity conservation, but also can serve as a source for funding the conservation of forests through ecosystem services provisioning. Therefore, information and assessments of forest functions and services is of paramount importance for the design and implementation of effective sustainable forest management options and forest related policies at the European level. Long term studies and observations of forest ecosystems can provide valuable indicators of ecosystem functioning and are key factors for improvement of ecosystems and natural resource management (Lindenmayer and Likens, 2009). This paper focuses on the positive impact of forests on human health and well-being in terms of ecosystem services and provides an example in practice which as a preliminary result provides a basis for establishment of health paths within the Tara National Park and implementation and valuation of these services in future research.

This study has been initiated to make a basis for future research considering forest ecosystem services, in terms of health improvement and promotion of health tourism. To carry out the analysis of potential of forests to induce human health improvement in the frame of Tara National Park, during this research, the existing literature and data considering forest ecosystems services and health, as well as locations of established hiking trails in Tara National Park have been analyzed.

2. Potential of forest ecosystem services in Serbia

Millennium Ecosystem Assessment set the current concept of ecosystem services which encompasses the fact that healthy and functional ecosystems generate array of benefits to humans that are in the focus of public interest. This study which was launched in 2001 by the UN Secretary General and completed in 2005 developed a conceptual framework in order to highlight the real impacts on human health, security, social relations and overall well-being.



Figure 1. Land usage in Serbia (source: National forest inventory of Serbia, 2009)

According to Platon et al. (2015) forests have important roles and functions, represented as: geomorphological, climatic, edaphic, hydrological, influence of forests on agriculture crops and influence of forests on human health. In recent years ecosystem services, its importance for society and environment have been a subject of numerous research, with the focus of determining the tools and methods for evaluation and quantification of these services (Zorić et al. 2018). Most researched forest ecosystem services in Serbia are focused on significant effects of forests on the protection of agricultural and forest lands against erosion. Also, forests are the most significant forms of vegetation in terms of net resources and the sequestration and retention of carbon, ensuring that activities such as beekeeping, hunting, sports, recreation, and tourism, are available to rural populations and for rural development (Orlović et al. 2012). Most forests in Serbia are located on mountains. The overall forest area in Serbia is 2,252,400 ha or 29.1% of its territory (Figure 1), which is considered to be medium forested country, but this percentage goes up to 75% in certain areas, such as in Tara National Park. Stated area under the forest in Serbia, in comparison to global values, is close to the average which is 30%, but is significantly lower than European average value which is 46% (Orlović et al. 2012).

Considering the data published in the Serbian National Forest Inventory (2009), 49 tree species are found to be dominant, from which 40 are deciduous and 9 conifers. The most dominant tree species in Serbia is beech, with total volume of 40.5%, followed by Turkey oak, Sessile oak, Hungarian oak, Hornbeam, Black locust, Common oak, Euramerican poplars and ash. Norway spruce as the most common coniferous tree species had a 5.2% of total volume, followed by Austrian pine and European silver fir.

Although Serbia is characterized as a medium forested country, research conducted for monitoring of ecosystem services showed that the area of Serbian forests has increased since the last inventory by 356,863 ha for state and 108,748 ha for private property (Orlović et al. 2012). These data serve as clear evidence that there is a raising potential for forest ecosystem services in Serbia, particularly in rural areas with low industry development and where urbanization is slowed down or absent. Serbian National Parks, mostly located in rural highlands still provide the sanctuary for forests and the conservation of biodiversity, while in the other parts of Serbia forests are mostly degraded due to industry and agriculture production. Considering the changed environment and climate changes, there is an urgent need for health improvement of forest ecosystems, as they will continue to degrade under the pressure of increased demands unless preventive and strategies of restoration are applied. Forest condition monitoring is a matter of global concern and indispensable tool for detection of negative impacts and developing measures for their mitigation (Nevenić et al. 2011). To ensure the optimum of ecosystem services through forest management, constant monitoring considering the condition and vitality of forests is needed (Orlović et al. 2014), as forest management could have larger impact on variations in ecosystem services provision than climate change. Main goals of forest ecosystems research should focus on the transfer of results of applied research to users in order to achieve adequate forest ecosystem vitality. In this way, the forest ecosystem functions could provide an optimal support and resources for bioeconomy, which will consequently secure the existence of forests in currently changed conditions.

3. Positive impact of forests on human health

Forests have always been an important part of human society, and its significance lays in providing sources for needed goods, but also for cultural and religious purposes. Nowadays, forests and trees affect human health and well-being in various ways: air purification, carbon fixation, and generation of essential oxygen for breathing. Furthermore, they are an important source of environmental safety and social and recreational services, especially considering the increasingly urbanized societies. Also, forests have a direct influence on human health regarding disease spread since they act as a certain barrier, but they also influence the quality and quantity of available water for drinking and household (Mullan, 2014). According to Van Herzele et al. (2011) people tend to acknowledge the importance of natural environments considering their health and wellbeing. More importantly, a basic awareness of health benefits of nature is evident in society in general, that can be attributed to increased number of research on the topic. Moreover, recent medical research have outlined that the positive impact of spending time in forests reduce symptoms of multiple health diseases and conditions (Ohtsuka et al. 1998; Li et al. 2009, Lee et al. 2011; Ochiai et al. 2015; Hansen et al. 2017). Considering the fact of stressed, high paced life in the urban areas, nowadays humans suffer from different so called "modern diseases" such as high blood pressure, cancer, diabetes, depression and pulmonary diseases due to the air pollution. Latest research published by Institute of Public health of Serbia, in Health Statistical Yearbook of Republic of Serbia (2016), provides alarming data that during 2016 the most common causes of deaths were diseases of the circulatory system (51.8%), neoplasms (21.8%) and diseases of the respiratory system (4.8%). High number of chronic patients who suffer from these diseases are affecting the overall well-being of Serbian population, but also the country economy. It was estimated that the annual cost per patient was 250 dollars, which is

about 4% of complete GDP. Other research showed that spending time in forests can decrease the symptoms of acute diseases, fasten the recovery after the surgery and have positive effects on perceived general health of users and socio-economic health (Hansen et al. 2017). Li et al. (2011) stated that habitual walking in forest environments showed relaxing effect in both female and male subjects which resulted in reduction of blood pressure and reduced anxiety. Other studies showed the decrement of cortisol in saliva, after just one hour spent in forest (Ochiai et al. 2015); lowering the adrenaline and the increment of natural killer (NK) cells which suppress tumor cells by the releasing anticancer proteins (Li et al. 2009). Moreover, decrement in levels of blood glucose is beneficial for diabetic patients (Ohtsuka et al. 1998). Although it is known that trees have positive effects on different health conditions, information on defined and tested tree genotypes and localities that can be used for human health improvement still lacks (Zorić et al. 2018). Some authors suggest that main activators of health improvement are aromatic volatile compounds called phytoncides that derived from trees, which are mostly consisted of groups of chemical compounds such as monoterpenes and sesquiterpenes (Li et al. 2009). These studies have opened a series of questions and challenges considering forestry, forest management and forest ecosystem services. According to Van Hezele et al. (2011) most challenging task is to apply this knowledge on relationship between nature and health in such manner that potential of this relationship is fully realized. From the ecological point of view, research emphasizes the existing linkage between human health and ecosystem health and functionality. This perspective will extend our understanding of nature and sources for human health, as nature degradation will increase the risk for human population health.

4. Forest ecosystem services in terms of bio-based economy and its social significance

Bio-based economy (bioeconomy) deals with parts of economy that are using renewable biological resources, such as forests, crops, animals, microorganisms for the production of food, materials and energy (Marchetti et al. 2015). Bioeconomy is based on sustainable production of biomass in order to enhance the use of biomass products which will result in reduction of the use of fossil-based materials and therefore suppress negative climate effects. Other aspects of bioeconomy are focused on the increment of biomass materials, in order to optimise the value and contribution of ecosystem services to the economy (Orlović et al. 2015). According to Marchetti (2014), the continuous flow of goods and services from the ecosystem to people is threatened by human activities and ruthless exploitation of the environment. The fact that natural resources are used with no control brought a number of research in the field of bioeconomy that are streamed towards raising awareness of the importance of natural resources for human health and well-being. Exploitation and commercialization of ecological and sociological effects of forestry and their branding and marketing promotion are the most important goals for bioeconomy. The implementation of these goals will result in direct improvement of users quality of life and health, but it will also enhance greater investment in ecosystem preservation and its health. Main focus should be to stop the loss of biodiversity and increase the provision of ecosystem services from a global to a local level. In this context, the forestry sector plays a key role in further promotion of sustainable development and "green growth" in degraded environments such as rural areas (Marchetti, 2014). In order to achieve better conditions for bioeconomy that deals with ecosystem services in forestry, a deeper understanding of biological processes in forests and its effects on humans, animals and the environment is needed. According to Wolfslehner et al. (2016), an important challenge for forest-based factor in bioeconomy is to overcome the narrow definition of forest resources and wood based products, including primary production. Besides timber as currently the most used forest resource, forests, as natural and semi-natural ecosystems provide many resources, ranging from oxygen, water, food, medicinal and genetic resources to sources of energy and materials for different industries. According to Mullan (2014), in developing countries forests contribute to

the income of local people, their health, safety, food and energy security. Additional research in the field of ecosystem services will result in the most advanced biological and technological know-how methods for forest production, as well as for environmental and social services of forest ecosystems. The method of quantification of ecosystem services is still insufficiently explored, so it is one of the main goals to develop precise methodology how ecosystem services will be quantified and valued in the future. Benefits of this method could be significant, both for the economy and people, especially in rural areas. Further research can lead to a change of the basic industrial resources and may contribute to the preservation of limited ecosystem resources.

5. The study area - Tara National Park

Tara National Park is one of the mostly explored National Parks in Serbia. First study to declare mountain Tara suitable for the status of National Park was conducted during 1951, but it was proclaimed as a protected natural resource in 1981 within the First Regulation on the National Park. The Public Enterprise "Tara National Park" has a full responsibility for the management of the park, and the total land in frames of this National Park is divided into five managing units, with a total of 751 parcels and sub parcels, with a complete area of 19,175 ha. The management of almost all natural potentials of Tara National Park is now primarily based on well-known principles of forestry, technology and management (Radović et al. 2005).

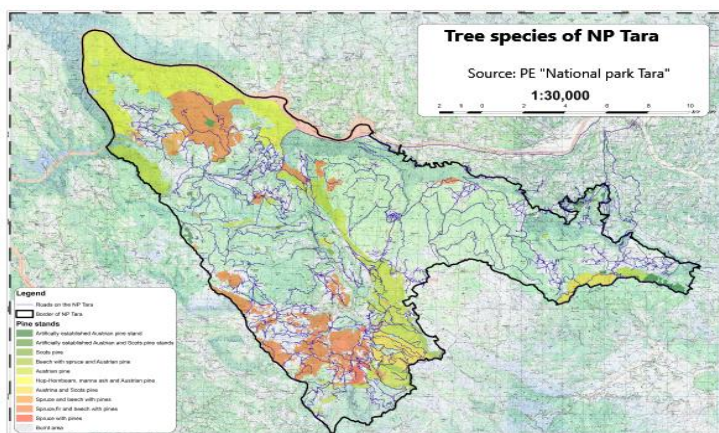


Figure 2. Most common tree species and its prevalence in Tara National Park (source: Tara National Park)

This National Park is situated in the western part of Serbia and includes Tara mountain, Crni vrh, Zvijezda, Stolac, Drina canyon with Perućac Lake and the surroundings of Bajina Bašta. The National Park is situated within the territory of the Bajina Bašta municipality. The park itself has an area of 19,175 ha, while the protected buffer zone that surrounds it has an area of 37,584 ha (Tomićević, 2010). The average altitude of National Park ranges from 1,000 to 1,200 m. The highest point of Tara National Park is Kozji Rid (1,591 m), while the lowest point is at 300 m, which made mountain Tara one of the medium-high mountains of Serbia. Within the Tara National Park there are permanently populated settlements: the village of Jagoštica, the village Rastište, the hamlet of Jasikovica (village Solotuša) and the hamlet Čokići (village Rača). Most residents are employed within the National Park, and highly depended on the ecosystem

services of this area, especially on forests, as the timber production is the most developed industry in this area. Other parts of Tara National Park that are not used by the local population have different purposes of use. According to data from Tara National Park, up to the 75% of territory of this protected area is covered up with forests. Most of the land in Tara National Park is used for growing forests for timber, biodiversity conservation, with the presence of completely natural, protected regions of exquisite natural beauty. Most common tree species in Tara National Park is spruce, followed by beech, fir and other conifers and deciduous trees (Figure 2).

The richness of this mountain lies in relict and endemic tree species. Regarding ecosystem services and human health improvement, species *Picea omorika* and *Pinus heldreichii* contain high levels of terpenes such as α -pinene and limonene (Nikolić et al. 2011; Bojović et al. 2011). Previous study (Li et al. 2009) showed that presence of α -pinene and limonene, along with other terpenes (β -pinene, β -cadinene) in the air can boost the activity and production of natural killer (NK) cells which could be highly beneficial for human immune system.

Tara National Park is among top favorite destinations for hiking, with the complete number of 30 marked hiking trails with different difficulty levels. Most of the paths are starting from popular settlements where tourists search accommodation such as Mitrovac na Tari or Kaluđerske Bare. Hiking trails lead to popular sightseeing places such as beautiful viewpoints, or numerous cultural, religious or historical monuments that can be found on Tara mountain.

6. The potential for forest health path establishment within hiking trails of Tara National Park

Health paths can be defined as natural environments which contain certain plant species that have positive effect on human health. With trees as their main element, health paths can be designed in unnatural environments, or established in natural areas with no negative effects on nature. Up to authors knowledge, there is a lack of data considering the exact list of tree species, its number and health status, that follows marked hiking trails. The main aim of this study is to assess the potential of Tara National Park hiking trails for forest health path establishment. Presented is the basis for future research on tree species found along these hiking tracks and its potential for health path establishment and human health improvement. The assessment has been done based on the description of 30 marked trails in three different areas in National Park Tara: Hiking trails in the western part of Tara, hiking trails near Mitrovac and hiking trails near Bajina Bašta (Figure 3).

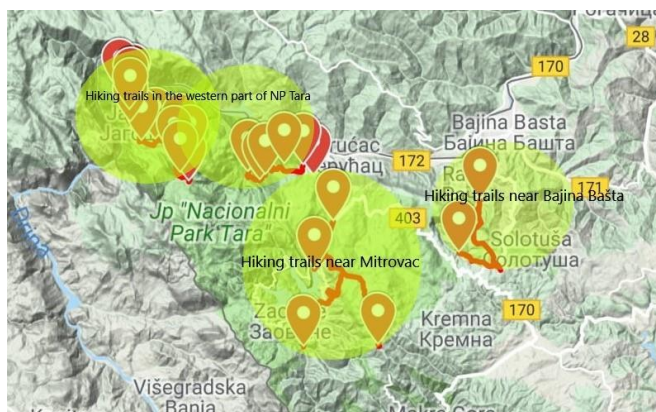


Figure 3. Groups of hiking trails in Tara National Park (source: Google maps, 2018)

First area, in the western part of Tara National Park is located far away from urbanised areas which is an important factor for tourists with health issues. There is also a small amount of tourist accommodations and the presence of higher number of wild animals compared to the other two areas which is repulsive to unexperienced hikers.

Hiking trails NP 'Tara' with potential for health path establishment

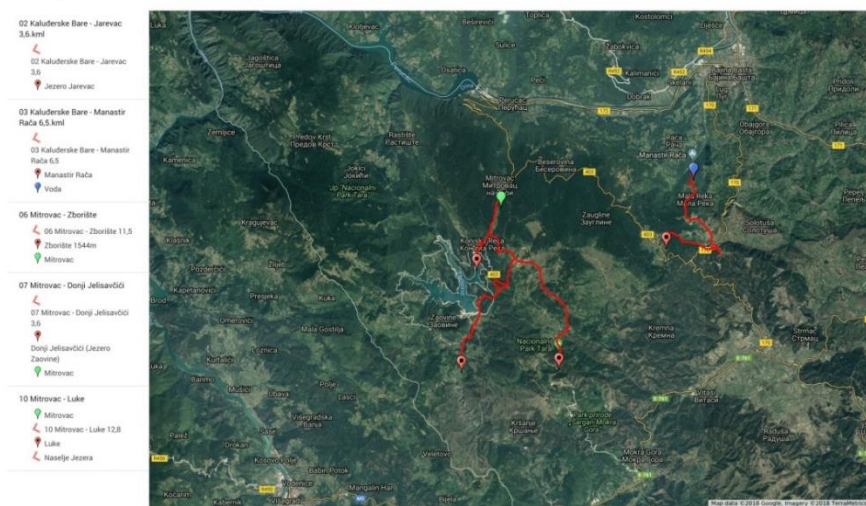


Figure 4. Area with hiking trails near Mitrovac as tourist centre, and near monastery (source: Google maps, 2018)

Also, there are threats for this highly protected area in terms of biodiversity loss and degradation if the number of tourists increases. Other two locations are described as more suitable for forest health path establishment (Figure 4). Hiking trails in these areas are characterized with low or medium difficulty for hiking, which will attract not only experienced trackers, but also a common visitor and nature lovers. The establishment of health path in order to develop health and recreational tourism has a potential to enforce the financial capacity of local people, but also improve the funding of Tara National Park. These trails were selected since some their parts go through the woods, where lies the opportunity for forest health path establishment. Also, the lack of forested areas within hiking trails gives an opportunity for forestation and further research on this subject. Five hiking trails are characterized as suitable for forest health path establishment. Three of them (Mitrovac - Zborište; Mitrovac - Donji Jelisavčići; Mitrovac - Luke) are starting from Mitrovac na Tari and leading to the shore of Zaovine Lake, to spectacular viewpoints. All of the three trails are characterized as hiking trails with low difficulty and the hiking itself lasts no more than three hours. Along every trail the check points are established and springs of drinkable water are marked (Figure 5).

The other two hiking trails (Figure 6) with a high potential for forest health path establishment are starting from Kaluderske Bare and lead to beautiful Jarovac Lake or Rača monastery built in the 13th century. This monastery has high cultural and historical values, but is also located near the woods, so its position ensures even greater potential of forest health path establishment. Other than that, it is easily accessible not only to hikers, but to other tourists. The potential for forest health path establishment within the hiking trail that leads to the Jarovac Lake can be located near the lake, where the trail goes through the forested area or near popular viewpoint Crnjeskovo.



Figure 5. Hiking trails starting from Mitrovac na Tari (source: Google maps, 2018)

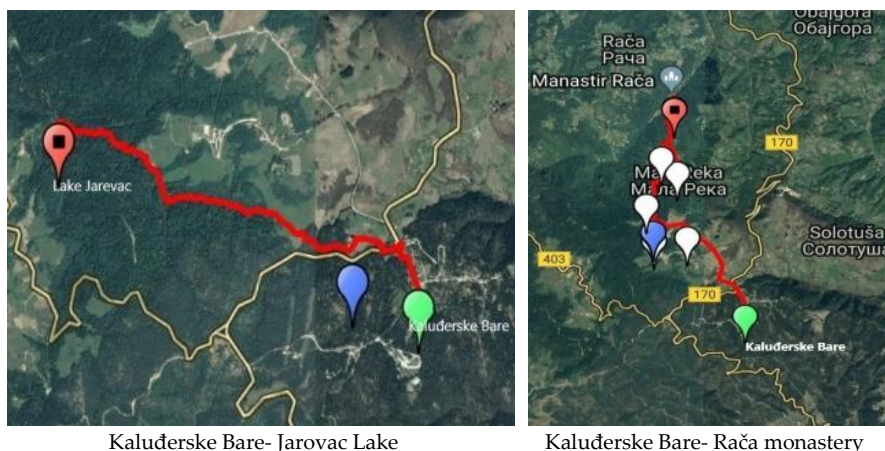


Figure 6. Hiking trails starting from Kaluderske Bare (source: Google maps, 2018)

7. Potential effect of forest health path establishment within the National Park Tara

The number of people suffering from "modern diseases" such as high blood pressure, diabetes, cancer and depression is increasing on a global level. Positive effects of trees and forests on human health are evident from different multidisciplinary medical and scientific research. Up to date, and according to authors' knowledge, there is a huge gap in existing results for assessment and valuation of these services. Moreover, there is a significant research potential in forestry for selection of certain tree species and its genotypes that have higher potential for reduction of symptoms of certain diseases. Forest health paths are not only research sites; they can be used as an unobtrusive method for human health improvement, but also they provide a resource for health tourism increment with various benefits for the local population within the Tara National Park. Future research on this subject and its implementation could have a high impact on increasing the awareness of forest importance for human health, which would allow decision-makers to enhance funding for forest management, preserving forest biodiversity and increment of forested areas on a global level.

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