POSSIBILITIES OF USING FOREST ECOSYSTEM SERVICES ON THE EXAMPLE OF RECREATIONAL FUNCTION

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Abstract

Renewable resources and their efficient, sustainable use are coming to the fore. Forest ecosystems provide a wide range of services that are vital for both human well-being and the health of the planet. As the recognition of the importance of ecosystem services grows, various financing strategies have been developed to support conservation efforts. The forest's recreational function can serve as an additional financial source for both public and private entities. Forests offer a wide range of recreational opportunities and experiences that attract visitors and tourists, generating revenue and supporting local economies. The article analyzes the question of the use the forest's recreational function, using the example of a treetop sidewalk in Bachledova dolina. The aim is to analyze the benefits and hazards related to the development of a treetop sidewalk as an object supporting the forest's recreational function. Economic research indicates that such a project would be both economically and financially efficient. Additionally, some positive socio-economic consequences on the investigated locality were observed, such as employment creation directly tied to the attraction's provision of services, as well as related occupations in gastronomic establishments and tourism. On the other hand, it is important to note that there are several undesirable consequences. These effects are mostly influenced by increased tourist traffic in the area, but they may also be influenced by a potential conflict between the project's owner and the impacted owners and users of forest land. In conclusion, it should be emphasized that it's important to manage the recreational use of forests sustainably to avoid negative impacts on the natural environment and to maintain the long-term attractiveness of the area. Balancing the conservation of ecosystem services with recreational activities can ensure that forests continue to provide economic benefits while preserving their ecological value.

Keywords: *forest ecosystem services, recreation function, economic and financial efficiency, treetop sidewalk*

1. INTRODUCTION

It is important to recognize and preserve these forest ecosystem services, as they are fundamental for sustaining life, biodiversity, and the health of the planet. Forest conservation and sustainable management are critical for ensuring these services continue to benefit current and future generations.

Ecosystem services (ES) can be defined very simply as the contributions of ecosystems (living systems) to human well-being (HAINES-YOUNG, POTSCHIN 2011). Although the concept appeared already after 1980, but it has received more attention only in the past twenty years, and especially in this decade, this attention is growing almost exponentially. Ecosystem services depend on the quality and quantity of natural resources. These natural resources are, for example, soil, air, water, but also biodiversity. We can describe the given natural resources as capital. Because of this, it is necessary to evaluate the relationship to the processes, functions and structure of the related ecosystems (MEDERLY ET AL. 2019).

Sustainability science is motivated by fundamental questions about interactions of nature and society as well as compelling and urgent social needs (CLARK 2007). the political and scientific communities undertook a massive synthesis of scientific knowledge about global ecosystems and their capacity to support human well-being, the Millennium Ecosystem Assessment or MEA (www.MAweb.org). MEA

(2005) Distinguishes four ecosystem services: supporting, supplying, regulating and cultural. Supporting services are services that maintain the life and functions of ecosystems necessary for the creation of other ecosystem services. Provisioning services represent to us benefits that are obtained from ecosystems as material goods and products. In this case, regulating services are the benefits obtained from the purposeful effect of the stability of ecosystem processes when they are affected by disturbing influences. Cultural services are intangible services that people get from ecosystems. This group also includes recreation, ecotourism and geotourism.

The view of recreation as a cultural ES is represented by two camps, whose claims are largely divided. The first camp is based on the works of BOYD & BANZHAF (2007) and FISHER Et Al. (2009) in which they argue that recreation is a benefit that is made up of multiple inputs and ES. These inputs can contribute to the production of recreational benefits by a certain number of ecological elements such as forests, meadows and the like. In the second camp are scientists who look at recreation as ES and define it as the restoration and stimulation of the human body and soul through exploration and interaction with living organisms in their natural environment (BEAUMONT ET AL. (2007), or as "pleasure, that people obtain from natural and cultural ecosystems" (NAHUELHUAL ET AL. 2013). Cultural ecosystem services, where the ecosystem provides an intangible benefit to people (LANKIA ET AL. 2015) is understood in its demand for a service that is closely related to the presence of people in ecosystems (NAHUELHUEAL ET AL 2013).The nature of the natural and cultivated landscape is an important landmark for spending free time in a given area (MEA 2005).

The recreational function is thus one of the basic ecosystem services provided by the forest. Currently, we are witnessing an increased interest of residents in its use. One of the tools to increase the population's interest in the forest environment is the construction of attractive modern recreational and tourist facilities, such as paths in the treetops, observation towers, observation ramps, via ferratas, educational and experience trails. Recreational and tourist facilities can attract a lot of people, they can be a tool for education and enlightenment of the general public about the forest and forestry, and at the same time they can become additional income for the owners and users of the forest. The aim of the submitted bachelor's thesis is to identify the benefits and risks associated with the implementation of such a project, namely the path through the treetops in Bachledová dolina, as an object supporting the recreational function of the forest. The work presents the project itself, the results of the analysis of financial and economic efficiency as a basic assumption of its long-term functioning, as well as the identification of positive and negative impacts of the analyzed investment on the concerned stakeholders.

2. MATERIALS AND METHODS

2.1. Materials

Bachledova dolina is located between the Belianske Tatry, Podtatranska brazda and Spišská Magura. It is listed in two cadastral territories, namely the village of Ždiar and the city of Vysoké Tatry (KOČICKÝ, IVANIČ 2011). It is already actively used for recreation in winter and summer.

The analyzed object is located at the top of the Magura hill, where a wooden lookout tower was located in the past. It allows a view of two mountains, Spišská Magura and Vysoké Tatry. It was put into operation in 2017. The architecture of the sidewalk accepts the requirements for making the object accessible to a wide group of people, including the physically handicapped. The footpath and its accessibility is suitable for all age groups. The architectural solution (Fig. 1) is the work of the German architect Josef Stöger, who used proven technical solutions in the design of his previous projects, such as: Tree Crown Trail Lipno and Valtou in the Czech Republic.

The observation tower is built in the shape of a pyramid with a base formed by an equilateral 12-sided prism. The height of the tower is 32 meters. The entrance to the observation tower was developed in the shape of a spiral, which is wrapped around the supporting core of the tower on its outer side and rises at a constant 6% slope. The supporting structure of this walkway, which stretches all the way to the very top of the observation tower, is made up of a system of wooden beams supported by steel beams.

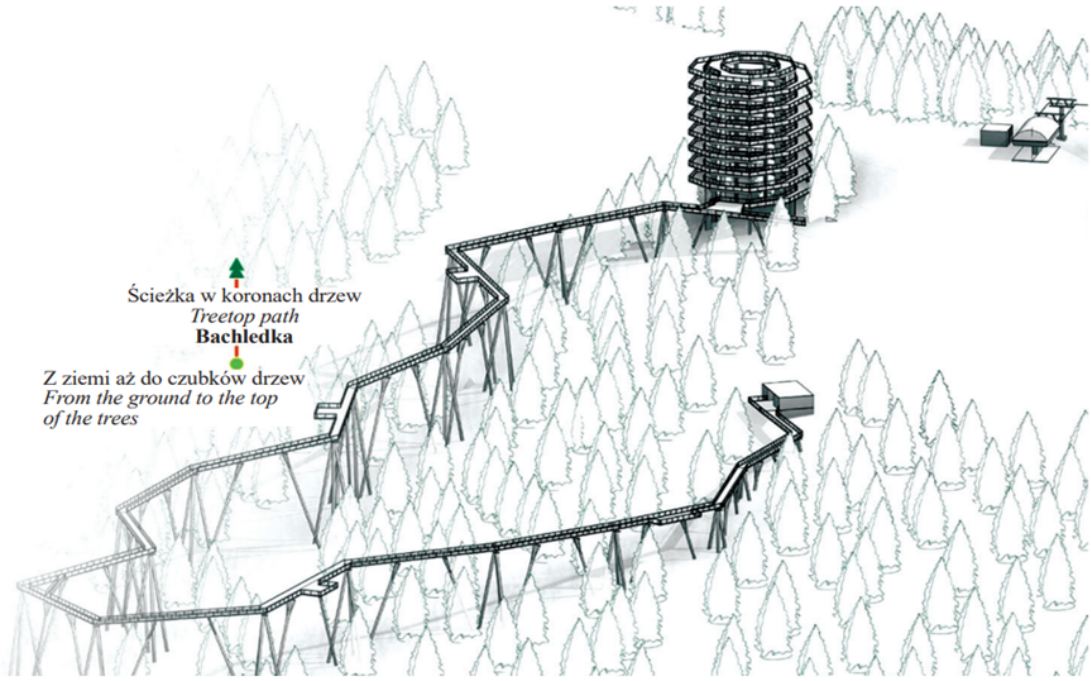

Fig. 1. Treetop path "Bachledka"

Source: STÖGER 2017 in CZERNIK 2019

At the top of the observation tower of the Bachleda path, there is a net that is suspended between the support columns of the tower, on which you can easily walk and jump. There are two ways tourists can get down from the lookout tower. The first is the aforementioned console and the second is a tunnel slide (dry slide). This slide is 61 meters long and ends at the level of the main entrance to the tourist attraction (CZERNIK 2019).

Table 1. Basic parameters of Treetop path "Bachledka"

Total length of the Trail	1 234 meters
Length of the Treetop path (separately)	603 meters
Length of the walk on the observation tower (separately)	631 meters
Height of the observation tower	32 meters
Height of the pathway	24 meters
The number of the abutments	120
Width of the pathkway	1,80 meters
Largest tree used	25 x 0,48 meters

Source: https://chodnikkorunamistromov.sk

2.2. Methods

The purpose of the submitted contribution is to assess the possibilities of using the recreational function of the forest as an additional source of financing for enterprises operating on forest land. The basis is a financial and economic analysis. The following were used in the evaluation process:

- Analysis of the structure and development of costs, revenues and economic results
- Analysis using ratio indicators
    - Return on Equity (ROE)
        - Percentage profit share from 1 EUR of equity
    - Return on Assets (ROA)
        - Percentage profit share from 1 EUR of the company's assets
    - Profit Margin (ROS)
        - Profit share per EUR 1 of sales
    - Liabilities to Assets (LTA)
        - The share of foreign sources in the financing of the company

The input data for the financial analysis was generated from the company's financial statements from the beginning of the construction of the walkway in the treetops (year 2017) to the last reported year 2022. The results are affected by the pandemic years 2020 and 2021, when the attraction was partially or completely closed as a result of the implemented anti-pandemic measures .

The direct interview method was used to identify the impacts of the implemented project on individual stakeholders. The interviews were conducted between August and November 2023. We focused on local residents from the area directly affected by the project. The owners of the forest land on which the building is located were also included in the interviews. The interviews were informal and focused on basic research questions:

- What positives did the implementation of the walkway in the treetops bring you?
- Does this attraction represent any restrictions for you?
- Do you perceive any positive/negative impacts of the sidewalk on your life and life in the given village/region?

In the case of forest land owners, we also inquired about the economic impacts and possible limitations in the forest land management system in the given location.

The achieved results are processed in textual, graphic and tabular form. On their basis, measures and critical areas were proposed, which must be taken into account when implementing similar projects aimed at supporting the recreational function of the forest.

3. RESULTS

3.1. Evaluation of the financial and economic efficiency of the project

The goal of the project economic efficiency evaluating is to demonstrate its economic viability. The implementation of the project, such as the analyzed path in the treetops, should also bring a positive economic effect for the implementers as well as the respective region.

Table 2 shows the basic financial data of the analyzed company. The presented results demonstrate its high potential, which was manifested in the growth and volume of sales in the first years of operation. The negative effects of the restrictions associated with measures against the spread of COVID 19 were manifested in a decrease in sales in 2020 and subsequently most significantly in 2021.

Table 2. Basic financial information about the project

	2017	2018	2019	2020	2021	2022
Revenue [EUR]	998 217	3 626	1 813 460	863	2 202 854	1 597 811
Profit/loss [EUR]	487 322	1 027 674	1 334 382	626 706	- 142	723 767
Assets [EUR]	4 854 614	4 813 751	958	374 358	729	5 094 549
Equity [EUR]	599 322	1 674 996	2 409 378	2 036	084	1 535 942

Source: financial statements of the company

In the last observed year, there is an increase in revenues, but their level does not reach the pre-pandemic years 2018 and 2019. Despite the lower revenues, the project is profitable and generates enough revenue to ensure its operation as well as possible expansion in the future (Fig. 2.).

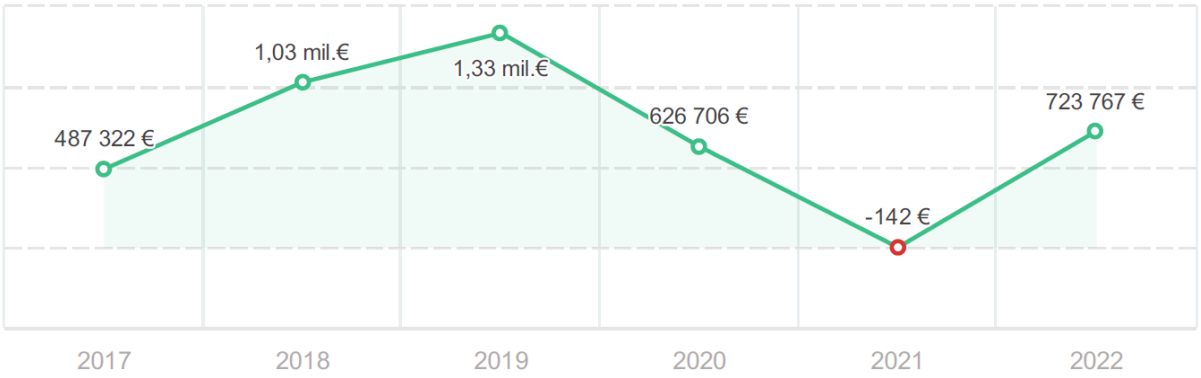

Fig. 2. Development of the profit over the lifetime of the projekt

Source: financial statements of the company

The viability of the implemented treetop walkway project is also confirmed by a financial analysis based on selected ratio indicators (Table 3). The only problematic year was 2021, when the negative effects of the measures to prevent the spread of COVID 19 were fully manifested. The high ROE ratio confirms the financial efficiency of this investment. This is subsequently transferred to the determined payback period of the project, which according to these input values is at the level of 2.25 years. The return on the investor's own funds is even shorter, as the ROE value is already 81.3% in the first year.

Table 3. Financial indicators of the project

	2017	2018	2019	2020	2021	2022
Return on Equity (ROE) [%]	81,3	61,4	55,4	30,8	-0,0	30,7
Return on Assets (ROA) [%]	10,0	21,4	25,7	14,4	-0,0	14
Profit Margin (ROS) [%]	48,8	30,6	38,6	28,4	-0,0	25,0
Liabilities to Assets (LTA) [%]	87,7	58,63	69,0	62,3	38,5	61,5

Source: authors

The results of the financial and economic analysis confirmed the profitability of the project. From the point of view of the return of financial resources, it is possible to evaluate the investment as stable and with a high rate of return.

3.2. Evaluation of the project social impacts

The treetop walkway changed the character of some villages and affected the daily life of local residents. The most affected municipality is Ždiar, in the cadastre in which the project is implemented. Other identified municipalities are those located in close proximity to the project, namely Malá Franková, Veľká Franková, Osturňa and Spišské Hanušovce (Fig. 3). To a lesser extent, the influence of the intention was also identified on surrounding towns such as Kežmarok or Spišská Belá.

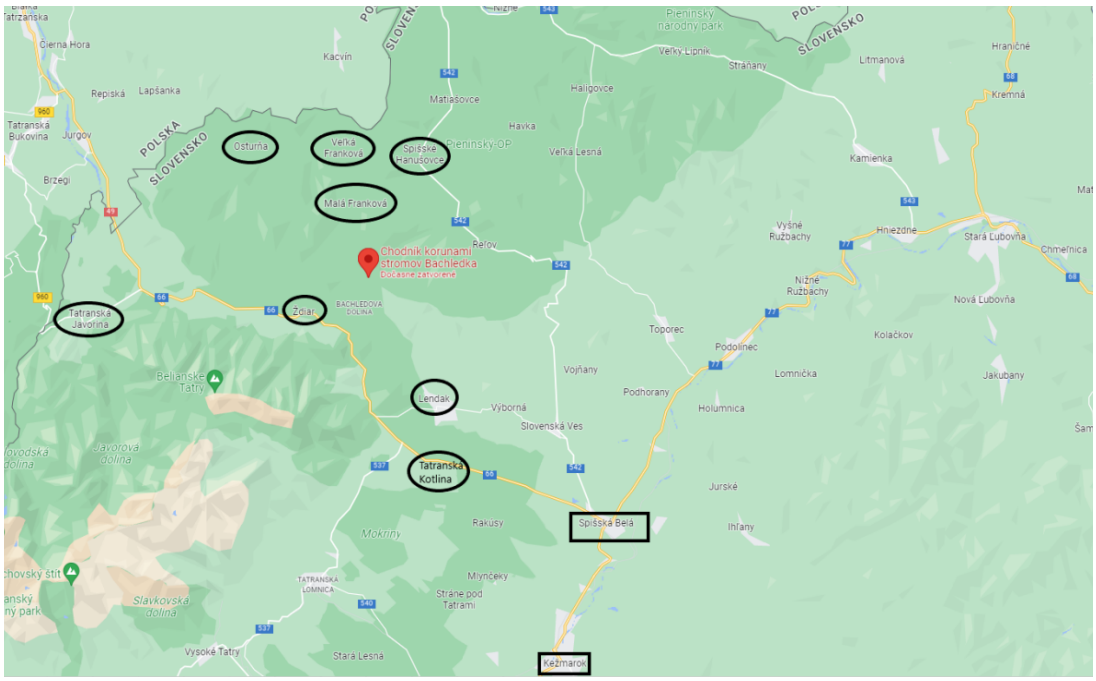

Fig. 3. Identification of involved villages and cities

Source: authors

For the residents of the villages, an opportunity arose for new job positions, as well as the possibility to start operating accommodation and restaurant services. Especially the inhabitants of the village Ždiar seized this opportunity, and accommodation became the main source of income for the residents. Some providers mentioned several problems, such as uneven income distribution throughout the year and dependence on weather conditions. However, those offering supplementary services, like wellness, found the utilization of accommodation capacities more evenly distributed throughout the year.

The treetop walkway has not only positive effects for the local residents but also some negative impacts of its implementation can be identified. These negative impacts primarily affect the most affected village, Ždiar. One negative aspect identified was the overall change in the character and appearance of the villages due to a significant increase in the movement of people and especially vehicles. The increased traffic during the peak season is particularly perceived as disturbing by the residents. Additionally, there has been an increase in dust and noise, which is seen by some as a loss of privacy and tranquility.

A significant problem identified by the mayors of the affected villages and the citizens is the amount of litter and disorder, not only in the vicinity of the walkway but also in the broader area. The lack of discipline among visitors and non-compliance with established rules has led to increased tensions

between the operators of the recreational attraction, local residents, and, to some extent, the owners and managers of the forested lands.

Significant socio-economic impacts have been caused by the construction of the treetop walkway on the owners and users of the forested lands where the project is located, as well as in adjacent areas. On the designated lands, timber harvesting has been restricted or completely suspended for the safety of tourists, leading to a decrease in income for the forest managers. Several elements of the forest road network have disappeared in the affected area, or their routes have been disturbed, necessitating redirection. Implementing the designated measures has had a negative impact not only on the revenue but also on the cost side for the forest managers. Ensuring the recreational function at the desired level incurs increased costs associated with preventive measures (fire protection, wildlife conservation) and maintaining accessibility and passability of the forest road network in the area. Partly, the loss of income and increased costs are compensated to the attraction owners through agreed-upon annual rent. Without information on the actual rent/compensation amount, its adequacy cannot be assessed. If a well-established agreement exists between the forest owners and users and the attraction operator, the payments for this service should cover the loss of revenue or increased costs associated with changes in land management.

The socio-economic impact of the treetop walkway project also needs to be evaluated in connection with the broader region, i.e., the Zamagur area. The region has utilized the advantages of the surrounding nature, easy accessibility, less demanding terrain, affordable accommodation, and the well-known Dunajec rafting. Marketing activities associated with the promotion of the new attraction have positively influenced public awareness of the region. Increased visitation, which also reflects in the number of overnight stays, has a positive impact on the revenue side of the municipal budgets. A significant increase is observed, especially in the collection of taxes and fees for accommodation. One problematic area identified was the transportation infrastructure. The investor built a new access road and a parking lot near the entrance of the walkway, but its capacity is insufficient, especially during the peak season. Local roads are also in poor technical condition, as they were not built to handle the current traffic load. Some of the affected municipalities (Ždiar, Malá Franková) have decided to address this issue on their own, which puts pressure on their budgets.

The survey results demonstrated a positive impact of the project on employment and entrepreneurial activities in the micro-region. The company directly operating the walkway employs 9 people throughout the year, and during the summer and winter seasons, it is on average more than double that number. The investment's multiplier effect has been reflected in subsequent areas, such as hotel and restaurant services (Table 4 and 5), small businesses specializing in traditional product production, as well as local growers and breeders.

Based on the data presented in Table 4. and Table 5., since the opening of the trail in the treetops, it is possible to observe an increase in the number of accommodation facilities, sales and the number of tourists in the Zamagura region. However, the growth is not continuous, as a result of the pandemic measures against the COVID-19 virus, there was a decrease in 2020 and 2021. In 2022, the region reaches the values from the pre-pandemic period.

Table 4. Development of accommodation services over the period 2017-2020 - District of Kežmarok total

	2017	2018	2019	2020	2021	2022
Total number of available accommodation establishments	112	138	163	154	166	183
Total number of available bedrooms	1 224	1 350	1 459	1 390	1 532	1 538
Total number of available bed places (including camping grounds)	3 890	4 273	4 626	4 587	4 814	4 800
Turnover from accommodation services (EUR)	5 070 454,00	6 477 159,00	7 036 763,00	5 229 200,00	5 162 477,00	9 065 336,00
of which						
foreign visitors (EUR)	1 690 823,00	2 159 168,00	2 042 948,00	1 228 645,00	776 646,00	2 050 557,00
domestic visitors (EUR)	3 379 631,00	4 317 991,00	4 993 815,00	4 000 555,00	4 385 831,00	7 014 779,00
Average price for accommodation services (EUR)	23,10	27,40	23,30	25,10	31,60	35,20
Net occupancy rate of bed places (per cent)	27,80	27,40	32,40	32,10	23,20	27,30
Net occupancy rate of bedrooms (per cent)	30,70	29,20	34,50	32,00	25,60	30,30

Source: Statistical office of the SR and authors

Table 5. Development of accommodation services over the period 2017-2020 – Municipality Ždiar

	2017	2018	2019	2020	2021	2022
Total number of available accommodation establishments	59	54	61	55	59	58
Total number of available bedrooms	484	458	548	523	539	511
Total number of available bed places (including camping grounds)	1 379	1 315	1 539	1 548	1 588	1 546
Turnover from accommodation services (EUR)	1 663 921,00	1 990 894,00	2 785 043,00	2 412 622,00	D	3 588 113,00
of which						
foreign visitors (EUR)	648 311,00	594 117,00	732 977,00	524 168,00	D	700 065,00
domestic visitors (EUR)	1 015 610,00	1 396 777,00	2 052 066,00	1 888 454,00	D	2 888 048,00
Average price for accommodation services (EUR)	21,40	21,80	24,10	24,80	D	47,30
Net occupancy rate of bed places (per cent)	25,20	30,30	33,20	41,50	D	26,60
Net occupancy rate of bedrooms (per cent)	26,70	31,60	34,50	41,60	D	27,90

Source: Statistical office of the SR and authors

4. DISCUSSION

Human welfare depends on ecosystems and the benefits they provide (COSTANZA ET AL. 1997). Externalities related to forest resources play an important role in their economy, as a natural consequence of the growing gap between the demand for public goods (such as water availability, air quality, landscape, and biodiversity protection) and the supply of goods and services generated by forests (TRAPANI ET AL. 2014).

The construction of the treetop walkway "Bachledka" negatively affects forest management in the area. The site is subject to non-intervention management and is located within the protected zone of TANAP, which means that forest owners and users are restricted in their management activities and gradually transition to non-intervention management. In the area of the implemented project, only selective logging is carried out, resulting in minimal revenues, and the capital invested in the stands is lost. Forest owners are often unable to generate revenue from the broader range of ecosystem services their forests provide, which forces them to base management decisions mainly on marketable goods, such as timber production (MAIER ET AL 2021, LINDAHL ET AL. 2017, RUHL 2010). ŠIŠÁK ET AL. (2011) pointed out the reluctance of the public to participate financially in providing improved non-market forest services. Most respondents suggested that payment should come partly or entirely from timber sales or public funds, such as the state budget, with only a minority suggesting it should come from forest users themselves. Therefore, it is necessary to explore additional alternative sources of financing. In this case, an agreement was reached between forest owners and the project implementers on compensations for the restriction of forest management. However, it is necessary to quantify the optimal amount of compensation and confront it with the existing payment.

The management of projects similar to the one analyzed is complex, and their operation is influenced by various external and internal factors. The benefits and risks of the analyzed project are summarized in Table 6. Given the different conclusions, three separate groups of stakeholders are identified.

- Local residents – citizens permanently or temporarily living in the affected municipalities of Ždiar, Malá Franková, Veľká Franková, Osturňa and Spišské Hanušovce,
- Owners and users of forest land - these are the owners and users of the forest, on whose land the construction of the path in the treetops is directly located, as well as the owners and users of adjacent land,
- Region – residents of the wider region, self-government in the affected locality. It can be defined by the micro-region of Zamagurie.

Currently, given the increasing importance of forestry in the transforming bioeconomy, it is necessary to pay increased attention to public engagement. One of the possible tools for such engagement can be projects like the treetop walkway. Through this project, by building an additional educational trail and adding informational boards related to forest management, the significance of forests, and the work of foresters, these projects can become a means to improve public awareness about forests and forestry as a whole.

Table 6. Opportunities and threats related to project implementation

Stakeholder	Opportunities	Threats
Local citizens	• Increase in employment • Support for small business • Increase demand for recreational services • Increase demand for restaurant services • Growth in the number of overnight stays • Support for producers and sellers of traditional regional products	• A sharp increase in the movement of foreigners in the affected municipalities • Increased traffic • Increase in dustiness and noise • Loss of privacy • Pollution of the village and its surroundings, a lot of garbage also in the vicinity of houses • Air pollution caused by increased traffic
Forest land owners	• Income from the lease of land under treetop path • Higher attractiveness of land, growth in landvalue	• High concentration of tourists • Increased movement of people on forest roads and mining routes

		• Risks associated with the movement of people outside the marked paths • Cycling outside the established routes • Excessive harvesting of forest crops • Requirement for non-interventional forest management • Limitations in forest management (in terms of volume, method and time of implemented measures)
District Zamagurie	• Improvement of infrastructure • Construction of civic amenities • Cultural enjoyment of the inhabitants of the region • Increase demand for recreational services • Increase demand for restaurant services • Growth in the number of overnight stays • Growth of municipal incomes - accommodation tax, fees • Growing interest of potential investors • Creation of new jobs • Making the region more visible • Support of regional business • Maintaining traditions	• Unsuitable or insufficient transport infrastructure • Increased traffic • Increased noise and dustiness • Increased movement of foreign persons • Creation of visual smog • Violation of the stereotype of municipalities • Expenditures for municipalities due to better infrastructure and its maintenance • Problems with ensuring the cleanliness and maintenance of municipalities and their surroundings

Source: authors

5. CONCLUSIONS

Forest recreation services play a crucial role in fostering the well-being of both humans and the environment. As we navigate the challenges of a rapidly urbanizing world and grapple with the impacts of climate change, the value of these services becomes ever more apparent. From providing a respite from the stresses of daily life to contributing to biodiversity conservation and climate regulation, forests are true multi-faceted treasures.

Forests play a crucial role in supporting human well-being and providing various ecosystem services, including recreational opportunities. As the demand for such services grows, the importance of sustainable forest management becomes even more evident. Projects like the treetop walkway exemplify how forests can be utilized for recreational purposes, generating additional income for forest owners while preserving the natural environment.

Recreational infrastructure, such as the treetop walkway, can attract tourists and visitors to explore the beauty and biodiversity of the forest ecosystem. This not only benefits the local economy through increased tourism revenue but also raises public awareness about the value of forests and the need for their conservation.

However, it is essential to recognize and address potential challenges and risks associated with such projects. For instance, increased human activity in fragile forest areas may lead to disturbances and impact the wildlife. Proper management and monitoring are crucial to mitigate any negative effects on the ecosystem and maintain the delicate balance between recreation and conservation.

Collaboration and stakeholder engagement play a pivotal role in the success of these projects. Involving local communities, forest owners, conservation organizations, and governmental bodies from the early stages of planning fosters a sense of ownership and responsibility. It also ensures that the interests of all parties are taken into account, promoting sustainable development that benefits both the environment and the local population.

Furthermore, the economic aspects of these projects should be carefully considered. While recreational services can generate additional revenue for forest enterprises, there must be a balance between commercial activities and conservation efforts. A portion of the generated income should be reinvested in the conservation and sustainable management of the forest to ensure its long-term viability.

In conclusion, projects that enhance the recreational function of forests, like the treetop walkway, present valuable opportunities for the economy, the environment, and public awareness. By adopting a comprehensive and participatory approach to forest management, we can strike a balance that allows us to enjoy the benefits of forests while ensuring their preservation for future generations.

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REFERENCES

1. Beaumont, J. N., Austen, M.C., Atkins, J.P., Burdon, D., Degraer, S., Dentinho, T.P., Derous, S., Holm, P., Horton, T., van Ierland, E., Marboe, A.H., Starkey, D.J., Townsend, M. & Zarzycki, T. 2007, "Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach". *Marine Pollution Bulletin*, vol. 54, no. 3
2. Boyd, J., & Banzhaf, S. 2007, "What are ecosystem services? The need for standardized environmental accounting units." *Ecological economics,* 63(2-3), p.616-626.
3. Clark, W.C. 2007, "Sustainability science: A room of its own." *Proceedings of the National Academy of Sciences* 104 (6), 1737–1738.
4. Costanza, R., D'Arge, R., De Groot, R., Farber, S., Grasso, M. et al., 1997, "The value of the world's ecosystem services and natural capital." Nature, 387(6630). p. 253-260
5. CZERNIK, S. J. 2019, "Architektura i konstrukcja współczesnych wież i ścieżek widokowych w koronach drzew na wybranych przykładach". *Architectus*, (4 (60)), 77-91.
6. Fisher, B., Turner, R. K., & Morling, P. 2009, "Defining and classifying ecosystem services for decision making". *Ecological economics*, 68(3), 643-653.
7. Haines-Young, R., & Potschin, M. 201,. "Common international classification of ecosystem services (CICES, Version 4.1)." *European Environment Agency*, 33, 107.
8. Bachledka, C. K. S. (n.d.). Chodník korunami stromov Bachledka | Objavte Tatry z korún stromov. Chodník Korunami Stromov. https://chodnikkorunamistromov.sk
9. Kočický, D. & Ivanič, B. 2011, *Geomorfologické členenie Slovenska* . Bratislava: Štátny geologický ústav Dionýza Štúra
10. Lankia, T., Kopperoinen, L., Pouta, E., & Neuvonen, M. 2015, "Valuing recreational ecosystem service flow in Finland." *Journal of outdoor recreation and tourism*, *10*, p. 14-28.
11. Lindahl, K.B., Sandstrom, C. & Stens, A. 2017, "Alternative pathways to sustainability? Comparing forest governance models" *Forest Policy Econ.,* 77 (SI), pp. 69-78

12. Maier, C., Hebermehl, W., Grossmann, C. M., Loft, L., Mann, C. & Hernández-Morcillo, M. 2021, "Innovations for securing forest ecosystem service provision in Europe – A systematic literature review." *Ecosystem Services,* Volume 52, 101374.
13. Mederly, P., Černecký, J. et.al. 2019, *Katalóg ekosystémových služieb Slovenska.* ŠOP SR, UKF v Nitre, ÚKE SAV, Banská Bystrica, 215 p.
14. MILLENNIUM ECOSYSTEM ASSESSMENT. (MEA) 2005,. Ecosystems and human well-being: wetlands and water Synthesis. World Resources Institute, Washington, DC.
15. Nahuelhual, L., Carmona, A., Lozada, P., Jaramillo, A., & Aguayo, M. 2013, "Mapping recreation and ecotourism as a cultural ecosystem service: An application at the local level in Southern Chile." *Applied geography*, 40, p. 71-82.2013
16. Ruhl, J.B. 2010, *Ecosystem services and federal public lands: Start-up policy questions and research needs* Duke Envtl. L. & Pol'y F., 20 (2010), p. 275
17. Šišák, L. 2011. "Forest visitors' opinions on the importance of forest operations, forest functions and sources of their financing." *Journal of Forest Science*, 57(6), 266–270
18. Trapani, A.M.D., Squatrito, R., FoderÃ, M., Testa, R., Tudisca, S. & Sgroi F. 2014, "Payment for environmental services for the sustainable development of the territory" *Am. J. Environ. Sci.,* 10 (5) (2014), pp. 480-488