# SUSTAINABLE MOUNTAIN TOURISM ACTIVITIES AND INFLUENCE OF FOREST LOSS

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**Abstract**

The mountain areas in Romania represent an essential ecological region with diverse ecosystems. Forests face threats, such as natural and anthropogenic factors, which drive significant forest loss areas. This paper explores a possible relationship between forest loss and tourism circulation in areas of mountain tourist resorts from the Carpathian Mountains of Romania. Forest loss in mountain areas is caused by multiple natural and/or anthropogenic sources, such as climate change and extreme weather events, deforestation, illegal logging, land use changes, and forest fragmentation. Results showed that the top deforested counties are related to mountain areas, with more than 52% of all tree cover loss between 2001-2023. Land use change and socio-economic modifications had a significant impact on forest management practices. The forest loss in Romania is mainly caused by human activities such as logging, land use changes, and forest fragmentation, amplified by climate change and extreme weather events. Several key strategies for sustainable mountain tourism are needed for successful sustainable tourism development, such as energy communities, local community involvement, and visitor satisfaction.

**Key words**: forest ecosystems, mountain areas, Romania, sustainable tourism

## Introduction

Forest ecosystems in Romania play a crucial role in biodiversity conservation, climate regulation and providing ecosystem services (Nichiforel et al. 2021). Climate change can alter weather patterns and affect natural attractions, which are vital for the tourism industry. Thus, sustainable forest management and ecotourism are essential to mitigate these impacts and ensure the long-term viability of tourism (Tavakolinia and Shams Pouya, 2022; Salimi et al., 2022). Forest restoration is crucial to preserving ecosystem services and promoting tourism. Forest loss persists even though the afforestation efforts are increasing globally (Sloan and Sayer, 2015). Romanian forests host unique species and ecosystems and UNESCO World Heritage sites, and these forests are pivotal for preserving diversity and maintaining ecological balance. Protecting virgin forests, part of Romania's natural heritage, requires state intervention and public awareness to ensure their preservation (Munteanu et al. 2016; Platon et al. 2019). The forests of the Carpathian Mountains face several threats as illegal logging, land ownership changes, intensified tourism development and land abandonment and socio-political factors (Vasile, 2020).

In addition to the benefits offered to the environment, forests offer biocultural and recreational benefits, contributing to human well-being and economic activities such as tourism (Platon et al. 2015; Ari, 2020; Pîrghie and Matei, 2020). The management of Romanian forests has been shaped by transitions from communist to post-communist governance, which influences current forest management practices and policies (Munteanu et al. 2016; Albulescu et al. 2022). However, Romania faces challenges such as illegal logging, climate change impacts, and the need for sustainable management practices. Efforts for long-term forest management are needed (Geacu et al., 2018; Tudoran and Zotta, 2020).

This paper explores the importance of tourism in forest areas, the consequences of forest loss on the tourism industry, and strategies for sustainable management in mountain tourist resorts from the Carpathian Mountains in Romania. The interchange between forest loss and tourism emphasises the importance of sustainable policies and effective forest management. Forests sustain natural attractions that are vital for tourism, and their loss can have prolonged repercussions.

**Materials and methods**

In the study area, we focused on the mountain tourist resorts of the Romanian Carpathian Mountains of national interest, focusing on some environmental characteristics, such as tree cover, tree cover loss and some other tourism characteristics, such as tourism: accommodation (number of units), circulation (number of tourists and overnight stays) for 2023.

Tab. 1: Mountain tourist resorts in the Carpathian Mountains

| Resort name | County | Number of accommodation units |
|---|---|---|
| Poiana Brașov | Brașov | 3505 |
| Predeal | Brașov | 2812 |
| Sinaia | Prahova | 1953 |
| Bușteni | Prahova | 1756 |
| Băile Herculane | Caraș-Severin | 1200 |
| Vatra Dornei | Suceava | 1147 |
| Gura Humorului | Suceava | 857 |
| Voineasa | Vâlcea | 798 |
| Râșnov | Brașov | 770 |
| Sucevița | Suceava | 610 |
| Băile Tușnad | Harghita | 575 |
| Ocna Șugatag | Maramureș | 509 |
| Câmpulung Moldovenesc | Suceava | 502 |
| Borșa | Maramureș | 479 |
| Borsec | Harghita | 422 |
| Moroeni | Dambovita | 415 |
| Covasna | Covasna | 354 |
| Azuga | Prahova | 321 |
| Dâmbovicioara | Argeș | 317 |
| Petroșani | Hunedoara | 288 |
| Geoagiu Băi | Hunedoara | 283 |
| Vișeu de Sus | Maramureș | 281 |
| Târgu Ocna | Bacău | 212 |
| Turnu Ruieni | Caraș-Severin | 206 |
| Sângeorz-Băi | Bistrița-Năsăud | 118 |

In Table 1, we presented all the mountain resorts from the study area, ranked according to the number of accommodation units. From an environmental point of view, these are situated in high mountain areas, covered with coniferous and deciduous forests. At the top are the Mountain Resorts, located in the most important tourism area of the country, from two counties Brașov and Prahova with over 2000 accommodation units. The other four resorts follow with over 1000 units and the other, below 1000 units.
For all the resorts, we analysed the tree cover areas and the tree cover loss and some statistical correlations were established. The analysis of tree cover loss in the mountain tourist resorts of the Carpathian Mountains was made using data from Global Forest Watch for a period of 22 years (2001-2023) (Hansen et al. 2013). The percentage of canopy cover used in the paper is ≥ 30% canopy cover as a default for all analyses, and the same is used for Global Forest Watch. The data processing was performed using descriptive statistics and was concluded in graphic and cartographic materials using Microsoft Excel and R Software platforms. The tourism data was collected from Tempo Online (a national database from the National Institute of Statistics).

**Results**
Figure 1, displaying the number of accommodation units, has some key observations. Poiana Brașov stands out as the leader, offering the highest number of accommodation units, close to 3,500. This indicates its popularity and capacity as a major tourist hub (Prahova Valley). Other resorts, Sinaia and Băile Herculane, follow, with approximately 2,500 and 1,500 units, respectively. These destinations also cater to a significant number of tourists. Gura Humorului, Râșnov, and Băile Tușnad form a middle tier, each with between 500 and 1,000 units. The remaining destinations, such as Sângeorz-Băi, Târgu Ocna, and Geoagiu Băi, have fewer than 500 accommodation units, indicating smaller or more niche tourist spots.
Some key trends and implications we can underline in this figure: there is a steep drop from the top three destinations to the rest, due to the concentration of tourist infrastructure in these locations. The resorts with fewer accommodation units may offer a more intimate tourism experience, while those with more ones accommodate larger tourist volumes and offer a wider range of services. There is a real disparity in accommodation capacity among tourist destinations, with Poiana Brașov, Sinaia, and Băile Herculane far ahead of the rest.

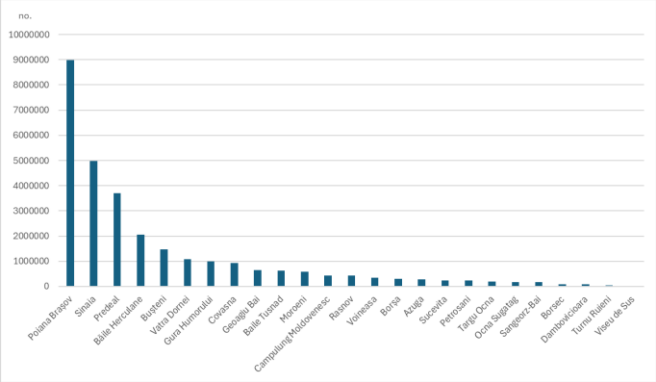



Fig. 1: The Mountain Tourism Resorts by the Number of Tourist Arrivals (2001-2023)

Being located in a mountainous area, as we can observe in Figure 2, most of the resorts have over 50% tree cover area, which means they are located in good environmental conditions. Below 50%, there are cities with a diverse palette of economic activities, the lowest being Brașov, one of the cities near the Carpathians. The figure visually compares the extent of tree cover loss in the study area, highlighting the resorts where the tree cover loss is more severe. The percentage of the tree cover loss, calculated as the tree cover loss per tree cover canopy by each year, from 2001-2023, the resort with the most loss of forest is Borșa, followed by the other resorts with the most diverse economic activities. The resorts with the highest rate of tree cover loss are Borșa, Vatra Dornei and Borsec, each with values above 20%. Others, such as Câmpulung Muscel, Vișeu de Sus and Băile Tușnad have also significant values. The figure also shows a wide range of resorts with the lowest rate of tree cover loss (Băile Herculane and Târgu Ocna).

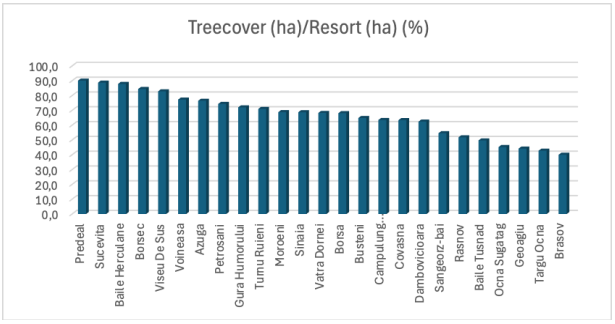



Fig. 2: Tree cover area per Resort in the Carpathian Mountains

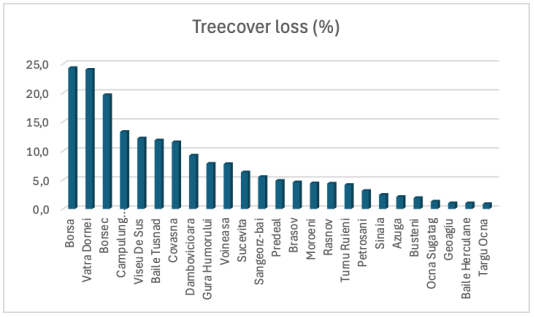



Fig. 3: Tree cover loss (2001-2023)

Figure 3 shows the tree cover loss by mountain tourist resorts, and there are differences from one locality to another. The highest rates of tree cover loss in the analysed period are recorded in Borșa (7019 ha), Vișeu de Sus (4470 ha), Voineasa (2776 ha), and Borsec (1528 ha). These localities are situated in large coniferous areas of the Eastern and Southern Carpathians. These mountains have protected natural areas to preserve the landscapes and local traditions, unique cultural heritages, which can encourage the development of tourism. High rates of tree cover loss determine the decrease in attractiveness to tourist places and endanger tourism development. The lowest rates of tree cover loss in mountain tourist resorts from the Carpathian Mountains are related to Târgu Ocna (18 ha), Băile Tușnad (11 ha), Băile Herculane (38 ha), and Ocna Șugatag (53 ha). These localities are situated in the Carpathians in depression areas.

Figure 4 displays the average length of stay (in days) for mountain tourist resorts as indicated by the names. Covasna and Sângeorz-Băi stand out with the highest average stays, both exceeding 5 days (5.05 and 5.02 days, respectively). This suggests these locations are particularly attractive for longer visits, due to their spa facilities or therapeutic offerings.

The next cluster (Vatra Dornei, Băile Herculane, Geoagiu Băi, Băile Tușnad) ranges between 3.57 and 3.00 days. This aspect indicates that they are also well-known spa tourist destinations, showing that the spa localities encourage longer stays. Many localities have average stays between 2.5 and 1.8 days, reflecting shorter visits. The localities with spa facilities, wellness programs have higher average stays. Tourist destinations from Prahova Valley (Bușteni, Predeal, Sinaia) have a shorter average stay due to a focus on weekend activities as skiing or hiking.

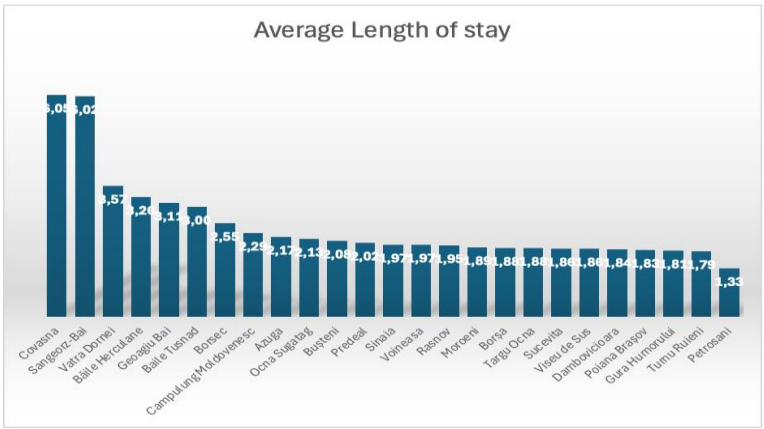
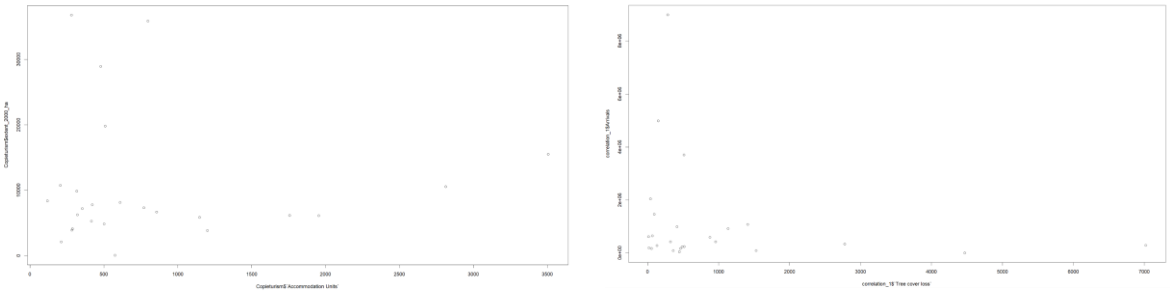



Fig. 4: Average length of stay in mountain tourist resorts

In Figure 5 (a,b), the data points are widely dispersed, indicating considerable variability in both the number of accommodation units and the extent in hectares. There is no clear or strong linear relationship between the two variables. The points do not form a distinct upward or downward trend. A few outliers are visible, particularly some points with very high extent (over 30,000 ha) but relatively low accommodation units. Some points with high accommodation units (over 3,000) but moderate extent. As we can observe, the lack of a clear trend may suggest that the size of the area is not directly proportional to the number of accommodation units. This could imply that some areas with large extents have limited accommodation infrastructure, while some smaller areas are more densely developed with accommodation units. The outliers may indicate unique cases (e.g., very large

protected areas with little development or small, highly developed tourist areas). A statistical correlation calculation could confirm the apparent lack of strong association.



(**a**) (**b**)

Fig. 5: (a) Correlation between accommodation units and tree cover (b) Correlation between tree cover loss and arrivals in accommodations.

In Figure 5, most of the points are clustered near the origin, indicating that the majority of observations have relatively low values for both tree cover loss and arrivals. There are a few outliers with much higher values, suggesting that in some cases, the two variables are significantly higher than the rest of the dataset. The spread of points does not show a clear linear or obvious pattern, which suggests that there may not be a strong correlation between tree cover loss and arrivals in this dataset. So, the lack of a clear trend or clustering along a line implies that increased tree cover loss does not consistently correspond with increased or decreased arrivals. The presence of outliers could indicate specific cases or regions with extreme values that may warrant further investigation.

**Discussion**

The relationship between forest areas and tourism growth is complex and varies across localities. In this paper, we explore the relationship between forest loss and tourism circulation in the Carpathian Mountains and the significance of forests for sustainable tourism activities. The highest rates of tree cover loss from Borșa, Vișeu de Sus, and Voineasa influence the landscapes and the local traditions, the unique cultural heritages of the Carpathians. Previous research has demonstrated the positive impact of tourism on forest conservation through sustainable tourism development (Kocak and Cavusoglu, 2024; Zhang et al. 2025).

Our research outlines the attractiveness of localities with spa facilities, therapeutic offerings which encourage longer stays as Covasna, Sângeorz-Băi, Băile Herculane, and Vatra Dornei. Other previous research traces the importance of leisure facilities (Kamata et al. 2010; Pîrghie and Matei, 2020; Zhang et al. 2025).

Also, economic growth is related to the improvement of forest landscapes, which is crucial for nature-based and sustainable tourism. The strategies for balancing tourism and conservation involve the community to enhance conservation efforts, and support sustainable tourism programs to preserve forests. The importance of infrastructure and planning in tourism growth is essential, and it was discussed in Munanura et al. 2020, Tampakis et al. 2019.

**Conclusion**

Our research revealed that the relationship between forest areas and touristic activities is not very highly dependent, but tourists prefer destinations with predominant green environments. Tourism can improve the local communities in mountain areas, contribute to sustainable development. Effective management, community engagement and strong legislative measures are important to harness the benefits of tourism in mountain tourist resorts in the Carpathian Mountains of Romania.

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**Souhrn**
Horské oblasti v Rumunsku představují zásadní ekologickou oblast s rozmanitými ekosystémy. Lesy čelí hrozbám, jako jsou přírodní a antropogenní faktory, které způsobují značný úbytek lesních porostů. Tento článek zkoumá možný vztah mezi úbytkem lesů a cestovním ruchem v oblastech horských turistických středisek z rumunských Karpat. Úbytek lesů v horských oblastech je způsoben mnoha přírodními a/nebo antropogenními zdroji, jako jsou změna klimatu a extrémní povětrnostní jevy, odlesňování, nezákonná těžba dřeva, změny ve využívání půdy a fragmentace lesů. Výsledky ukázaly, že nejvíce odlesněné okresy se týkají horských oblastí, kde v letech 2001-2023 došlo k úbytku více než 52 % všech stromů. Změny ve využívání půdy a socioekonomické úpravy měly významný dopad na způsoby hospodaření v lesích. Úbytek lesů v Rumunsku je způsoben především lidskou činností, jako je těžba dřeva, změny ve využívání půdy a fragmentace lesů, umocněná změnou klimatu a extrémními povětrnostními jevy. Pro úspěšný rozvoj udržitelného horského

cestovního ruchu je zapotřebí několik klíčových strategií, jako jsou energetické komunity, zapojení místních komunit a spokojenost návštěvníků.

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