

CONSIDERATION OF TOURISM DEVELOPMENT AND ENVIRONMENTAL DEGRADATION IN THE SANICA RIVER VALLEY (NORTHWEST BOSNIA AND HERZEGOVINA)

Ahmed Džaferagić¹
Lejla Žunić²

DOI: 10.35666/25662880.2025.11.163

UDC: 338.48:502(497.6-16)

Abstract: In recent years, Bosnia and Herzegovina has experienced a significant increase in the number of tourists. Many of the main tourist attractions are associated with rivers, particularly those in karst areas characterized by waterfalls and cascades. In tourism promotion, rivers are often presented as unique, untouched, and wild environments. However, increasing environmental degradation has been observed, primarily as a result of uncoordinated spatial planning, hydrotechnical interventions, and weak institutional control in river corridors that are simultaneously promoted as tourist attractions. On many rivers, despite representing primary tourism resources, riverbanks and riverbeds have been severely degraded within a relatively short period. This issue is especially evident along rivers such as the Una and Pliva, where environmental activists have initiated actions aimed at their protection, although other watercourses have also experienced significant degradation.

This paper focuses on the Sanica River, located in the municipalities of Ključ and Sanski Most, whose course has been exposed to strong anthropogenic pressure in recent years. In certain sections, large retaining walls and embankments have been constructed, weekend houses built, artificial dams erected, trees removed, and illegal waste disposal sites formed. The aim of this paper is to highlight the consequences of uncoordinated spatial management and inconsistent environmental policies, as well as their implications for tourism development and the degradation of major tourist attractions. The purpose is to encourage all relevant stakeholders and institutions to take greater responsibility for environmental protection and to promote a more balanced and sustainable development of tourism. The research methodology includes remote sensing and repeat photography, among other methods. The first part of the paper provides an overview of previous research and outlines the specific characteristics of the Sanica River, while the second part focuses on tourism development and environmental degradation.

Keywords: tourism development, environmental degradation, karst, tufa, Sanica River, Bosnia and Herzegovina

¹ Senior Teaching and Research Assistant, Department of Geography, University of Sarajevo – Faculty of Sciences, Zmaja od Bosne 33-35, 71000 Sarajevo, Bosnia and Herzegovina, ahmed.dzaferagic@pmf.unsa.ba

² Associate Professor, Department of Geography, University of Sarajevo – Faculty of Sciences, Zmaja od Bosne 33-35, 71000 Sarajevo, Bosnia and Herzegovina, lejla.zunic@pmf.unsa.ba

INTRODUCTION

In recent years, global interest in tourism has been increasing, particularly in forms of tourism related to nature. Bosnia and Herzegovina is recognized as a country of great natural diversity and rich cultural and historical values that attract a growing number of tourists. Considerable effort is being invested in promoting tourist destinations and developing tourism infrastructure, and tourism has been recognized as a strategic branch of the economy in many regions. However, due to the absence and ineffective implementation of tourism development plans—beyond a declarative level—uncoordinated and ad hoc spatial development is taking place, in which individual actors play a dominant role and often use space and natural resources in ways that are not aligned with broader public interests. In addition to limiting economic benefits for public institutions, such practices result in environmental degradation and contribute to the creation of a negative image of tourist destinations.

Some of the most important tourism resources, particularly rivers—especially those in karst areas characterized by cascades, waterfalls, and rapids—are exposed to strong anthropogenic pressures. These pressures are primarily associated with uncoordinated spatial management, hydrotechnical interventions, weak institutional oversight, and non-compliance with environmental regulations. As a result, numerous examples of riverbank encroachment, riverbed degradation, and deterioration of water quality have been recorded. Due to insufficient institutional response, as well as irresponsible actions by individuals, accelerated degradation is occurring, posing a risk of the loss of the natural and environmental values for which these rivers are recognized as important tourism resources.

The most pronounced problems have been observed on the Pliva and Una rivers, whose preservation and protection have been the subject of intensive environmental campaigns. This paper presents the main forms of environmental degradation and provides a critical review of official narratives on tourism development and environmental protection, which are often inconsistent with the actual situation in the field. Special focus is placed on the example of a smaller karst river in northwestern Bosnia and Herzegovina—the Sanica River—whose protection has received limited attention despite clear and increasing threats to its natural values, even though it represents an exceptionally important natural and landscape resource.

SOME CHARACTERISTICS AND VALUES OF THE SANICA RIVER

The Sanica River is located in northwestern Bosnia and Herzegovina, within the territories of the municipalities of Ključ and Sanski Most. Due to its water discharge, the morphological specificities of its valley and course, as well as the length of its flow, it is considered the most important tributary of the Sana River. It is approximately 22 km long, with an average discharge of about 14.8 m³/s. The river springs at the foothills of Mount Grmeč, at the contact with the Sanica Basin, from three powerful karst springs situated at elevations between approximately 220 and 240 meters above sea level. The springs are located at the contact between Jurassic–Cretaceous limestones and Permo-Triassic clastic rocks, which form the basal and lateral hydrogeological barrier and condition the discharge of underground water accumulations from the areas of Mount Grmeč and Bravsko Polje, which largely constitute the catchment of these springs. In terms of water quantity, the most significant spring is Pećina (more commonly known as the Sanica Spring, the main source). Upstream from this spring are large periodic springs, Jasenak and the Sanica Lake. In the upper course near Donji Budelj, the Korčanica River flows into the Sanica; it also originates from several springs, and due to the proximity of its sources to those of the Sanica, as well as the appearance of the spring zones and springs themselves, the Korčanica spring area is considered part of a wider spring zone of the Sanica. The Korčanica contributes a significant amount of water, which also originates from the areas of Mount Srnetica and Bravsko Polje. In addition to the Korčanica, there are numerous smaller tributaries—the Sanička River, Trebunj, Biljanska River, and Glibaja (Temimović, 2009; Temimović & Džaferagić, 2016.)

Due to the gentle longitudinal gradient, a large part of the river course is impounded, and the Sanica exhibits characteristics of a lowland river. Only a smaller section of the course through the Sanica Basin, up to the settlement of Donji Budelj, shows features typical of upper-course streams— a narrow channel, dominant vertical erosion, and predominantly bedload sediment transport. The middle and lower courses, from Donji Budelj to the confluence of the Sanica with the Sana near Vrhpolje, are characterized by an alternation of valley widenings—basins—and constrictions—gorges and canyons. In the lower course, the riverbed is wide and features numerous tufa barriers, behind which the water is impounded. Moreover, these tufa barriers host numerous cascades and waterfalls, giving this part of the river special landscape values and making the Sanica a typical tufa-forming karst river.

Hydrological, hydromorphological, hydrogeological, and hydrobiological studies conducted to date indicate characteristics and specificities typical of karst watercourses. One such specificity is the large fluctuation in discharge. Maximum recorded discharges (around 330 m³/s) exceed average—and especially minimum—discharges (0.8 m³/s) by several tens of times (Projekat zaštite izvorišta vode za piće Sanica, 2005; Hidrološki godišnjak: knjiga 1, 2017). Another specificity is the high proportion of dissolved magnesium in the river water, due to the presence of dolomitic rocks in the catchment, which is considered one of the key factors for tufa deposition in the riverbed.

Tufa itself is another distinctive feature, particularly because in the lower course it occurs in large masses, forming numerous cascades and playing an ecological role in regulating water levels (Spahić et al. 2000). The cascades and rapids formed on tufa give the watercourse special landscape values that greatly contribute to the tourism value of the Sanica, while the ecological role—through the regulation of water levels and discharge, i.e., the impoundment of the river course—is reflected in the provision of favorable conditions for plant and animal life during dry summer periods. Another specificity of the Sanica's course and valley is the presence of relict and endemic plant and animal species in its valley (the spring zone, gorges, and within the river itself).

Its natural values have attracted many visitors, particularly anglers engaged in fly fishing. National fly-fishing championships are regularly held on the Sanica and Korčanica rivers, and it is important to note that the Sanica has repeatedly served as a venue for the Premier League of Bosnia and Herzegovina in fly fishing, as well as hosting the World and European Fly Fishing Championships in 2010.

RESEARCH METHODOLOGY AND DATA SOURCES

The research methodology includes the collection, analysis, and critical evaluation of the results of previous studies. These are mainly related to projects on the sanitary protection of water sources, periodic reports on the chemical and biological quality of water, meteorological and hydrological observations of discharge and river water temperature, scientific articles, and especially expert works of a synthetic character covering broader geographical and thematic units.

As the focus of this paper is on recording hydromorphological changes (since these are the most visible, directly affect tourism values, and contribute to environmental degradation), the methods of remote sensing and repeat photography were applied. The remote sensing method involved the use of satellite imagery from the Google Earth service available for the period from 1985 to August 2023. It was used to monitor the destruction of tufa barriers, i.e., tufa waterfalls.

The repeat photography method refers to the comparison of photographs taken during field surveys of the river and was also used to assess the destruction of tufa waterfalls as well as the riverbed in certain sections of the course. Furthermore, GIS technology was used for data storage and spatial organization. In addition, in order to consider official governmental positions on tourism and the environment and to compare them with the actual situation, an analysis of strategic documents from different levels of government was included. These included water management plans, statistical yearbooks, statistical data from angling associations, cadastral land records, population bulletins, economic development strategies, and laws on water, the environment, agricultural land, spatial planning and construction, etc.

In the context of monitoring hydromorphological changes as well as environmental policies, media articles related to activists' opposition to hydrotechnical works and river regulation were also used, particularly those concerning the regulation of the Sanica River channel from the settlement of Vrelo to the settlement of Donji Budelj during 2021.

RESULTS AND DISCUSSION

Tourism Development

Official statistics do not record the number of tourists, the duration of their stay, or the motives for their visits, and therefore it is not possible to confidently speak about quantitative indicators of tourism development. However, based on indicative indicators—including field observations, conversations with local residents and owners of hospitality establishments, and the number of one-day fishing permits issued by fishing associations—there is a noticeable increase in the number of tourists in the Sanica River valley.

Indirect indicators also include an increase in accommodation capacities and the number of hospitality establishments. During the summer, four to five restaurants operate periodically in the Sanica valley, along with several bungalows and weekend accommodation facilities for tourists. Most tourists are foreigners from Central and Western Europe, as well as visitors from the countries of the former Yugoslavia. The main motive for visiting is fishing, primarily fly fishing on the Sanica River. For this purpose, fishing areas have been established, and the local authorities of the Ključ municipality have recognized the Sanica as one of the main tourist attractions.

Overall, it can be said that the number of tourists in the Sanica valley has noticeably increased over the past few years. Accordingly, there has also been an increase in

accommodation and hospitality capacities. Tourism activities are primarily focused on fishing and river-related activities.

Although there is growth in tourism activities, observed environmental degradation limits the tourist potential of the Sanica River. Construction of facilities, riverbed regulation, and other interventions affect the natural environment and reduce the quality of the visitor experience. These findings indicate the need for coordinated tourism planning and the protection of natural resources.

Environmental Status

The assessment of the environmental status of the Sanica River includes hydromorphological changes, flow variations, water quality changes, and other indicators. In this study, the focus is limited to hydromorphological changes, as they are the most visible and directly related to the river's tourism value.

Research indicates that at 25 locations between 2010 and 2025, significant changes were recorded in the riverbed and along the banks, including concrete embankments, deepening and narrowing of the riverbed, construction of small dams, disposal of municipal waste near the banks, and increased erosion due to tree cutting. Larger works, including riverbed regulation and the construction of embankments, are particularly visible along the stretch from the settlement of Vrelo to Donji Budelj (Fig. 1.). The impact of individual activities, although limited to smaller areas, significantly degrades the riverbed and surrounding environment due to the number of affected locations. One example of individual impact on riverbed degradation is the construction of stone walls and the destruction of the waterfall along the right bank of the Sanica River, between Vrhpolje and Hrustovo (Fig. 3. and 4.). Similarly, the middle course of the river is affected by large deposits of municipal and construction waste, particularly at the Kordići site (Fig. 2.).



Fig. 1. (top left): Riverbank embankments on the Sanica River near the settlement of Donji Budelj;

Fig. 2. (top right): Municipal and construction waste dump at the Kordići site, located directly along the Sanica River;

Fig. 3. (center left): Stone wall and damaged part of the waterfall on the Sanica River near the settlement of Vrhpolje;

Fig. 4. (center right): Position of the riverbank (yellow line) and the stone wall in the Sanica riverbed (red line), according to cadastral data from the Federal Geodetic Administration;

Fig. 5. (bottom left): Waterfall at the mouth of the Sanica into the Sana with approximate position (yellow line) before collapse. Photographed in summer 2025;

Fig. 6. (bottom right): Changes in the morphology of the waterfall from 2011 (before the downstream Sana riverbed regulation) to 2025, based on Google Earth satellite images.

These findings indicate that tourism activities themselves are not the primary drivers of hydromorphological degradation, but rather that tourism is affected by the consequences of poorly planned hydraulic engineering works and inadequate institutional governance.

Anthropogenic hydromorphological changes are most often associated with hydraulic engineering works aimed at regulating the flow, preventing floods, providing easier access to the river, or expanding parcels. Expert and scientific opinions indicate that most of these changes lead to environmental degradation. Some segments of the local population perceive these works positively, particularly when the riverbed is channeled and concreted, which highlights the need to raise awareness about the ecological values of the river. Examples of significant changes include the regulation works on the Sana River in Tominsko Polje (2013), which led to altered hydrodynamics and accelerated deep erosion, causing the deterioration of the travertine barrier and waterfall at the mouth of the Sanica (Fig. 5. and 6.). These works also included the construction of retaining walls and the illegal disposal of waste by local residents, further contributing to environmental degradation.

These results indicate that responsibility for hydromorphological changes was partially borne by both individuals and institutions in charge of water management. The lack of coordination and oversight resulted in interventions that, although technically justified, had a negative impact on the natural values of the river.

Environmental Impact on Tourism

It is a logical and well-known fact that the degradation of the riverbed and travertine barriers reduces the tourist value of the river. Since rivers generally represent complex and complementary tourist attractions, it is clear that river degradation also affects the value of other attractions.

The connection between the environment and tourism is evident in the following way: while tourism depends on a preserved natural environment, unplanned and degrading interventions reduce the attractiveness of the destination. The findings indicate the need for an integrated management strategy for the Sanica River, which includes planning and monitoring hydraulic engineering works, controlling waste disposal, and educating the local population about the importance of preserving natural values. This chapter confirms that sustainable tourism development cannot exist without the protection of natural resources, especially in travertine-forming rivers such as the Sanica.

CONCLUSION

The analysis of the relationship between tourism and the environmental status of the Sanica River shows that the local population largely lacks awareness of the river's ecological value, while inspection services often fail to sanction improper waste disposal and illegal construction within the riverbed.

Although tourism is often perceived as a pressure factor, the results of this study show that the main drivers of environmental degradation in the Sanica River valley are hydrotechnical interventions and institutional shortcomings, while tourism largely suffers the consequences of these processes. Official positions of actors at all levels of government are focused on tourism development and positioning tourism as a strategic economic sector. However, intensive negative anthropogenic activities lead to river degradation, which calls into question the objectivity and effectiveness of these positions and intentions.

By comparing various data sources, official narratives, and the actual situation in the field, it can be concluded that the Sanica River is experiencing accelerated environmental degradation through negative hydromorphological changes. In practice, this means a reduction in the river's tourist value, which contradicts the official narratives portraying the Sanica as one of the main tourist attractions in the municipalities of Ključ and Sanski Most.

The main causes of negative environmental impacts are:

- unplanned construction of buildings directly along the river and, consequently, poor solutions for flood management (deepening of the riverbed, construction of embankments),
- non-compliance with nature protection regulations in the use of concession rights for fish farms (deepening and changes in the riverbed),
- institutional negligence and actions that contradict the objectives established in strategic documents.

A particular problem is the lack of awareness of the natural values of the watercourse, which is evident in the planning of river regulation works solely from a hydraulic engineering perspective, without considering the ecological and other values of the river.

It is concluded that tourism development and environmental protection must be aligned. Examples of the degradation of the Sanica River, resulting from non-enforcement of laws and irresponsible institutional actions, should serve as a warning and incentive for all actors to consistently apply existing laws and plans. The Sanica River represents a complex and complementary tourist resource that, with appropriate protection measures and sustainable development, can bring significant economic and ecological benefits.

REFERENCES

Literature:

1. Spahić, M., et al., 2000. Sedra rijeke Une i Una bez sedre. Bihać: Privredna komora Unsko-Sanskog kantona – Društvo “Unski smaragdi”.
2. Lučić, I., 2023. K bosanskom oceanu: Kratki ogledi o percepciji prirode u Bosni i Hercegovini. Zagreb-Sarajevo: Centar za krš i speleologiju – Synopsis doo.
3. Milašinović, Z., Zovko, D. & Lukić, I., 2010. Sanacija korita i vodopada na rijeci Plivi u Jajcu. *Građevinar*, 62(8), pp.723-729.
4. Rudarski institut, 2005. Projekat zaštite izvorišta vode za piće Sanica, općine Bosanski Petrovac i Ključ. Tuzla: Rudarski institut.
5. Temimović, E., 2009. Rijeka Sana – potamološka studija. Ključ: Goldprint.
6. Temimović, E. & Džaferagić, A., 2016. Reljefna obilježja sliva rijeke Sanice. *Acta geographica Bosnia et Herzegovinae*, 3(6), pp.53-67.
7. Temimović, E. & Džaferagić, A., 2017. Hidrogeološka kategorizacija terena u slivu rijeke Sanice. *Acta geographica Bosniae et Herzegovinae*, 4(8), pp.47-62.

Sources:

1. Federalni hidrometeorološki zavod, Agencija za vodno područje rijeke Save & Agencija za vodno područje Jadranskog mora, 2020. Hidrološki godišnjak: knjiga 1: hidrologija. Sarajevo: Federalni hidrometeorološki zavod.
2. Općina Sanski Most, 2005. LEAP - Local Environmental Action Plan Sanski Most. Sanski Most: Općina Sanski Most.
3. Federalni zavod za statistiku, 2024. Statistički godišnjak/ljetopis Federacije Bosne i Hercegovine: 2024. izdanje. Sarajevo: Federalni zavod za statistiku.
4. Općina Ključ, 2021. Strategija razvoja općine Ključ 2014-2023: Revidirana strategija razvoja općine Ključ 2021-2027. Ključ: Jedinstveni općinski organ uprave općine Ključ.
5. Razvojna agencija Unsko-Sanskog kantona, 2020. Strategija razvoja Unsko-Sanskog kantona 2021-2027. Bihać: Razvojna agencija Unsko-Sanskog kantona.
6. Federalni zavod za statistiku, 2024. Unsko-Sanski kanton u brojkama. Sarajevo: Federalni zavod za statistiku.

7. Službene novine Federacije BiH, 2006. Zakon o vodama, br. 70, pp.7624-7653.
8. Službene novine Federacije BiH, 2021. Zakon o zaštiti okoliša, br. 15, pp.109-134.

Online sources:

1. CZZS, 2023. Čuvari Sanice i Korčanice ne smiju ostati usamljeni. [online]
Available at: <https://czzs.org/cuvari-sanice-i-korcanice-ne-smiju-ostati-usamljeni/>
[Accessed 15 Dec. 2025].
2. Impulsportal, 2021. Ekološki aktivisti: investitor nema dozvolu za radove na Sanici. [online] Available at: <https://impulsportal.net/zivotna-sredina/ekoloski-aktivisti-investitor-nema-dozvolu-za-radove-na-sanici>
[Accessed 15 Dec. 2025].
3. BHRT, 2025. Sanica – selo velikog turističkog potencijala. [online] Available at: <https://www.bhrt.ba/sanica-selo-velikog-turisticko-potencijala>
[Accessed 15 Dec. 2025].
4. Katastar.ba, n.d. Orthophotos and cadastral data. [online] Available at: <https://www.katastar.ba/>
[Accessed 15 Dec. 2025].
5. Slobodna Bosna, 2025. Zločin nad prirodom: u strahu za vodopad i sedru rijeke Plive, Jajčani hitno traže inspekciju zbog radova na obalama Plive. [online]
Available at: https://www.slobodna-bosna.ba/vijest/349122/zlochinnadprirodomustrahu_zavodopadi_sedru_rijekeljajchani_hitno_traze_inspekcijuzbog_radovana_obalama_plive_foto.html
[Accessed 15 Dec. 2025].
6. Žurnal, 2021. Uređivali rijeku zbog poplava pa uništili floru i faunu. [online]
Available at: <https://zurnal.info/clanak/uredivali-rijeku-zbog-poplava-pa-unistili-floru-i-faunu/24515>
[Accessed 15 Dec. 2025].