

## Article

# Water Quality Estimation and Population's Attitudes: A Multi-Disciplinary Perspective of Environmental Implications in Tara National Park (Serbia)

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**Abstract:** The paper analyzes the water quality of hydrological resources in the wider area of Tara National Park (NP Tara) in Serbia and the opinions of the local community and the national park visitors about the grade of the possible damage. The pollution level of the Drina River at the Bajina Bašta hydrological station was analyzed using the Water Pollution Index. The results showed that water quality corresponded to classes II (clean water) or III (moderately polluted water) and revealed the presence of organic pollution. In addition, using a survey combined with field research, the perceptions of local inhabitants and national park visitors related to environmental pollution were analyzed. The community believed that tourism does not cause significant damage to the environment. However, the older and more educated groups of residents and visitors had a more critical perception of the environmental impact of tourism. The results also indicated that the perceptions of visitors were mostly in agreement with measured water quality in the Drina River. The findings of this study have important implications for the management of protected areas and future policies related to national parks.

**Keywords:** Drina River; NP Tara; population's perceptions; tourism impact; Water Pollution Index (WPI)



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## 1. Introduction

In many European countries, including Serbia, special attention is paid to the protection and preservation of water resources and the environment, as they are identified as crucial for sustainable development in the 21st century. Therefore, in 2000, the European Union adopted the Water Framework Directive (WFD) (Directive 2000/60/EC) as a guideline for action regarding the protection, restoration and improvement of water bodies. For all surface waters, the EU WFD requires a good ecological status, i.e., a low level of changes of the natural state due to human activities [1]. Also, it is noteworthy that the protection and improvement of water resources have become one of the most important segments of the broader debate about the sustainable development of tourism in the 21st century. The intact natural environment, where water resources are dominant, is an asset that can create a competitive advantage for any tourist destination. For that reason, the awareness of the visual qualities and the level of water pollution are essential when planning and managing tourist activities related to hydrographic sites. This is particularly important for different categories of protected natural areas, where water resources are dominant.

The adequate protection of water resources includes activities such as water monitoring, water classification and the regulation of water quality standards. When implementing these activities, it is very important to evaluate water quality indicators (physical, chemical and biological), which have been referred to in many studies [2–10]. The concept of

indexing water with a numerical value to express its quality, based on physical, chemical and biological measurements, was developed in 1965 by the National Sanitation Foundation (NSF) in the United States [11], and it has been known as the Water Quality Index (WQI). This index is often used to assess the quality of both surface water [12–17] and groundwater [18,19].

As the evaluation of water quality and pollution requires an assessment of the ecological and chemical status of water resources, it is necessary to interpret the results in simple and objective terms by combining a large data set of physical, chemical and biological quality elements. For this purpose, researchers often use the Water Pollution Index (WPI) as a simple set of water pollution indicators, which facilitates the evaluation of water quality status in different water bodies. It has already been used for the river water quality and pollution assessment in Latvia [20], Serbia [21,22], China [23–26], and Indonesia [27]. In addition, the WPI index has also been used for the water quality assessment of the White Sea [28], the Danube–Tisza–Danube canal system in Serbia [21] and the Tapi Estuary in India [29].

As society's concern for the health of water resources and the natural environment is increasing, the influence of public perceptions on environmental management and policy is becoming more intensive. According to some authors, social factors are crucial for environmental management and conservation because humans play a central role in shaping the processes of environmental change [30–34]. Moreover, it has become broadly accepted that engaging with the human dimensions of conservation and environmental management is required to create productive conservation policies and effective outcomes and actions [35–37]. In this context, the opinions of residents living within protected areas, as well as visitors to these areas, should be interpreted as an important indicator of the current state of natural resources, as well as of the emerging problems regarding environmental protection. Tourism may be a reason to protect and preserve resources, but it may also damage them, as is often the case in attractive and fragile ecosystems. This lays focus on the importance of environmental awareness and the sensitivity of the local people [38–43].

There is a consensus in the literature that the support of the host communities is essential for the successful development of tourism in a community. Residents' hostile behavior toward tourists could interfere with tourism development; by contrast, a friendly attitude could support the progress of the tourism sector [44]. It is also known that economic benefits arising from tourism do not always result in socioeconomic benefits and environmental sustainability [45].

Local residents are often aware of the duality of environmental impacts in their community: they are both positive and negative [46]. Residents value the fact that tourism improves the appearance of their community and surroundings [47] and helps preserve natural resources [48]. On the other hand, residents are also aware that tourism stimulates noise [49] and overcrowding [49,50], causes pollution [46] and increases the quantity of garbage in the community [51]. This tourism-related inconvenience and damage can give rise to negative perceptions of tourism among the local population [44]. Community attitudes toward tourism and its impact on the natural environment have specific importance at a time when privatization of the natural resources, ecological problems and an increasing trend toward governance all intersect [38].

Visitors' experiences in national parks may influence their level of support for a protected area. If a national park does not meet their needs, they may be unlikely to support such parks, and this may indirectly affect biodiversity conservation and social equity [52]. Due to this, it is suggested that understanding visitors' perceptions is of great value to resource managers [53]. Also, the perceptions of the management body of the national parks can provide valuable information for future actions [54]. Visitors to natural sites are increasing in number and the study of perceptions can help identify visitor types, eventually leading to more successful management [55]. To measure visitors' satisfaction and perception, numerous studies have been conducted [52,56–62]. The literature data

show that the experiences of visitors and their level of satisfaction with the visit to a protected area may be affected by numerous factors. Studies have shown that higher levels of visitor satisfaction are related to repeated visits to a tourist destination because the pleasure experienced motivates people to visit the same area once again [63]. Multiple studies have found that demographic (gender, age) and socioeconomic factors (socioeconomic status, cultural traits, previous experience, etc.) influence the perception of the environment's quality in the protected area [32,64,65].

In light of the above, this study was focused on the assessment of the water quality in the Tara National Park in Serbia, as well as on the analysis of opinions related to environmental pollution. Two groups operating on the tourism market—local residents and national park visitors—have participated in the survey research related to environmental pollution, which partly included the quality of water resources. Although the tourism of NP Tara is mostly based on natural resources (primarily the Drina River), little is known about the population's perception toward the state of these resources. Moreover, no research has been carried out to investigate if the real (measured) quality of river water is in agreement with the opinion of different segments of the population. To fill these gaps, our research aims to identify the possible matches and to improve the knowledge on the importance of clean hydrographic resources for the overall sustainable development of this protected area. Also, this study presents a new perspective on water quality in the context of tourism development.

## 2. Study Area

The Tara National Park is located in the west part of Serbia, on the border with Bosnia and Herzegovina, and it covers the largest part of the Tara Mountain. The Tara Mountain is delimited to the north and west by the elbow valley of the Drina River, to the southwest by the valley of the Rzav River, and to the south by the Kremna valley, which separates it from the Zlatibor Mountain (Figure 1). This mountainous area is a unique geographic entity, reaching about 45 km in length and up to 18 km in width; the average elevation is 1200 m a.s.l., and its highest peak is Kozji Rid (1591 m a.s.l.) [66].



**Figure 1.** Location of the study area.

The NP Tara was declared in 1981 and it extends over the territory of the Bajina Bašta municipality. Its special feature is the Drina canyon, reaching up to 1000 m in depth. Its average altitude is about 1100 m a.s.l. Two tourist settlements are located at the site:

Kaluđerske Bare and Mitrovac [66]. The unique natural features (complex relief, diverse geological substrate and climate characteristics) and the isolated position of the mountain have enabled the development and survival of a variety of plant and animal species, with a significant percentage of endemic and relic species. One of the crucial features of the NP Tara is the forest ecosystems, which cover more than 78.8% of the total area of the mountain [67].

The area of the national park is dominated by natural tourist values: geomorphological (mountainous areas, gorges and canyon river valleys), hydrological (rivers, waterfalls and lakes) and biogeographical (forest ecosystems, endemic and relict species). The most significant anthropogenic tourist values belong to the category of artistic with historical character (Rača monastery and the archeological sites). The basic form of tourist traffic is recreational tourism, and there are also ecotourism, adventure, children's and youth, rural and event tourism. The basic tourist facilities are the hotels Omorika and Beli Bor in Kaluđerske Bare, as well as the hotel Drina in Bajina Bašta and the garni hotel Villa Drina in Perućac (the last two outside the borders of the national park). Among the complementary capacities, the Children's Resort in Mitrovac stands out and a large number of private houses and apartments that are rented out to tourists within several tourist settlements on the mountain and at its foot (Kaluđerske Bare, Šljivovica, Sokolina, Osluša, Predov Krst, Mitrovac). Catering capacities are present in Kaluđerske Bare, Mitrovac and Perućac and are mainly specialized in the national cuisine. All information for visitors are provided in Tourist Information Centers in Mitrovac and Bajina Bašta, as well as the Information Checkpoint on the shores of Lake Perućac. For visitors, there are six pedestrian paths that mainly lead to the viewpoints, for which the NP Tara is especially famous, with appropriate signage, info-boards and arranged rest areas. The first trail for disabled visitors in Serbia was constructed in NP Tara on Mitrovac. A network of marked hiking trails 290 km long is also available to visitors. The complex of indoor and outdoor sports facilities is available at Kaluđerske Bare within the two mentioned hotels, as well as at Mitrovac within the Children's Resort. The organization of tourist activities in the area of the national park is handled by the public enterprise Tara National Park, tourist organization of Bajina Bašta and several receptive tourist agencies. Domestic tourists dominate among the visitors, staying on average 3.8 nights, while the period of stay of foreigners is somewhat shorter (3.2) [68].

The main water resource of the NP Tara is the Drina River, which surrounds the mountain from the northwestern and northern sides, running along its foothill from the confluence of the Derventa River into Lake Perućac. The most important part of the stream, with deep cliffs, is the most recognizable tourist attraction of the area. The cruises organized along the Drina include boat cruises through the river canyon, and trans-border tourist tours, i.e., sailing from Perućac (Serbia) to Višegrad (Bosnia and Herzegovina). By damming the river at the village of Perućac in 1962, the Lake Perućac was formed (more than 50 km long, 80–500 m wide and 85 m deep) [66]. As the maximum water temperature of the lake is around 22 °C, and the mean temperature is about 18 °C, the bathing season lasts from July to August. Due to the cliffy character of the valley, owing to which the coastline is significantly shifted when water levels are changing, the natural terrain is almost unusable for beach recreation. For this reason, pontoon beaches are used for recreational purposes [69]. On the Drina River, numerous cultural, tourist and sporting events are organized. A specific type of event, for which the area is famous, is regattas, which are organized to celebrate the long tradition of rafting on the Drina River.

### 3. Materials and Methods

In two independent studies (the assessment of the water pollution level in the Drina River and the survey of the local population and the visitors of the NP Tara), we used different methodological approaches. These two pieces of research were implemented to make useful comparisons and draw constructive conclusions.

The water quality of the Drina River has been analyzed in several studies and papers by applying different methodologies. Thus, physicochemical parameters were analyzed on 12 selected sites in the Drina River basin in 2013 for irrigation in agriculture [70], water quality on the Drina River in Serbia was analyzed at four hydrological stations in the period 2004–2011 by using the WQI [71], and at two hydrological stations in the period 2006–2010 by using the WPI [69]. Also, the assessment of the water–food–energy ecosystems nexus and the benefits of transboundary cooperation in the Drina River basin was done by the United Nations Economic Commission for Europe in 2017 [72]. In order to analyze water quality and water pollution level in the Drina River the WPI was used in this study.

The Water Pollution Index (WPI), as a combined index, includes physical, chemical and microbiological quality elements for water quality assessment. It provides a good explanation of the main pollution factors and enables an easy comparison of the water quality data for various water bodies. According to Lyulko, Ambalova, and Vasiljeva [20], the WPI is the sum of the ratios of the measured annual average value parameters ( $C_i$ ) and the prescribed maximum values of water quality class I (SFQS) for each parameter, divided by the number of used parameters ( $n$ ):

$$WPI = \sum_{i=1}^n \frac{C_i}{SFQS} \times \frac{1}{n}. \quad (1)$$

For the given water quality classes, each country defines the standard threshold values for all parameters. In Serbia, they are established at the national level by several legal documents: the Regulation on Parameters of the Ecological and Chemical Status of Surface Waters, and the Parameters of the Chemical and Quantitative Status of Ground Waters [73], the Regulation on Emission Limit Values for Pollutants in Surface and Ground Waters and Sediments and the Deadlines for Their Reaching [74] and the Regulation on the Limit Values of Priority Substances and Priority Hazardous Substances Polluting Surface Waters and the Deadlines for Their Reaching [75].

The calculated WPI values for watercourses can be classified into six different classes (Table 1). Based on this methodological approach, the obtained results in this study enabled us to determine the water quality classes for the Drina River.

**Table 1.** Water quality classification according to the Water Pollution Index (WPI) [20].

Class	Characteristics	WPI
I	Very pure	$\leq 0.3$
II	Pure	0.31–1.0
III	Moderately polluted	1.01–2.0
IV	Polluted	2.01–4.0
V	Impure	4.01–6.0
VI	Heavily impure	$> 6.01$

In this paper, the pollution level of the Drina River was analyzed at the Bajina Bašta hydrological station. It is not located within the national park; however, it is the closest hydrological station. Apart from the analysis for this station, there was no possibility for more detailed WPI analyses on other hydrological resources of the NP Tara, primarily on Lake Perućac, Lake Zaovine and larger tributaries of the Drina. The reason is that there were no continuous measurements of physical, chemical and biological parameters of water quality at these hydrological resources. Also, on the Drina River, the parameters for water quality were measured at four hydrological stations (Bajina Bašta, Ljubovija, Jelav, Badovinci) until 2011, and since 2012 they have been observed only on two profiles, Bajina Bašta and Badovinci, which is downstream from Bajina Bašta, near the confluence of the Sava River into Drina River.

In order to analyze the WPI, the data of 18 physical, chemical and biological parameters were used. They were collected between 2007 and 2018 by the Republic Hydrometeorologi-

cal Service of Serbia (RHSS) using relevant standard methods. The parameters included: dissolved oxygen (DO), SRPS H.Z1.135; oxygen saturation (OS), SRPS H.Z1.135:1970; pH value, SRPS H.Z1.111; suspended solids (SS), 13.060.30 SRPS H.Z1.160; biochemical oxygen demand (BOD<sub>5</sub>), SRPS ISO 5813:1994; chemical oxygen demand (CODMn), JUS ISO 8467, ISO 8467; nitrite (NO<sub>2</sub><sup>2-</sup>), SRPS ISO 6777; ammonium (NH<sub>4</sub>), SRPS ISO 5664; metals (Fe and Mn–APHA 3111-B: 1998; Ni–APHA 3113-B: 1998 EPA 249.2; Hg–EPA Method 245.5; Cu–APHA 3113-B: 1998 EPA 220.2; Cd–EPA 6800:2007); sulfate (SO<sub>4</sub><sup>2-</sup>), APHA AWWA WEF 4500SO<sub>4</sub>; orthophosphate (PO<sub>4</sub><sup>3-</sup>), APHA AWWA WEF 4500-P; saprobic index (S) and coliform bacteria (CB).

Having completed the first part of the research, we conducted a survey of the local population and visitors to the NP Tara to assess the perceived state of the environmental issues. Also, one of the main goals of the research was to compare the perceptions of the surveyed population with the results of the WPI analysis. The survey was part of wider research on the indicators of sustainable tourism development in NPs in Serbia [69]. Some results of this research have already been published [65,76]. The authors used two questionnaire models recommended by the UN World Tourism Organization [77] for the analysis of sustainable development indicators related to the local community satisfaction and the satisfaction of tourists. This paper addresses the sections of the surveys related to environmental issues and the impacts of tourism on nature. The questionnaire analysis was conducted following selected socio-demographic indicators.

When it came to community, the data gathering procedure involved the use of the structured self-administered questionnaire. The interviewer personally distributed this document to the households and invited one person from each family to participate in the survey, with a short explanation of the subject and purpose of the research (persons under the age of 18 did not take part in the study). Due to the fact that local residents were mostly unfamiliar with survey procedures, questions were asked directly to the respondents, and the interviewer filled in the questionnaire after getting the oral answers. Community members were informed the survey was anonymous and stimulated to give credible judgment.

The questionnaire consisted of various claims representing the four spheres of tourism influence (economic, socio-cultural, legal/moral and environmental impacts). However, in the case of this particular research, only the environmental sphere was investigated, especially the statements directly/indirectly connected to water resources. To measure the residents' opinions, four items were evaluated: environment, utilization of natural resources needed by the local population, infrastructure quality (roads, water supply, sewerage, garbage collection) and opening new services (health, communal). The last two variables could also indicate the economic and social aspects of the impact of tourism. The measurement items of the recognized impacts were constructed so that respondents had the autonomy to determine the degree to which they observed those impacts as being positive or negative (with a bipolar scale ranging from 1 = Significantly worsening to 5 = Significantly enhances (stimulates)).

The survey also contained an open-ended question regarding the current problems of tourism development, where the answers of the respondents were coded and classified into certain thematic categories in order to interpret the obtained results.

The procedure of collecting the field data included a stratified random-sampling method. The sample of the local population included the respondents from the settlements within or along the boundaries of the NP Tara, where contacts between the community and tourists were the most intensive. The survey was conducted in five villages (Rastište, Solotuša, Rača, Beserovina and Perućac), as well as in the municipal center (Bajina Bašta), on a sample of 210 randomly selected respondents.

Similar to the previous group, the data gathering procedure involved the use of a structured self-administered questionnaire for visitors. The research was conducted in the form of an intercept study, which implies personal contact, generally in a public place. The interviewers mostly started a conversation with the potential respondent near tourist

attractions or visitors' centers and invited them to participate in the survey while briefly interpreting the subject and the purpose of the research. If tourists agreed to participate, the interviewer read the questions and entered the answers or, in some cases, gave the questionnaire to the respondents to fill out themselves. In accordance with the common practice in this type of the research [61,78], the visitors were informed their involvement was anonymous and they were encouraged to answer honestly.

The questionnaire comprised three sections: the characteristics of the visitor and visit, activities undertaken and perceptions. In this paper, the authors focused on the part of the survey related to visitors' perceptions, i.e., on attitudes related to the environmental state, which partly included the state of water resources. For this purpose, four items were used: overall cleanliness of destination, cleanliness of hydrological objects, beaches and wider coastal areas, presence of garbage in public places and overall environment state in the form of statements. The respondents were required to rate the state of the environment in the NP by using the Likert-type scale (with a scale ranging from 1 to 5).

The visitors were approached randomly and they were surveyed in the two largest tourist settlements within the NP Tara—Kaluderske Bare and Mitrovac—on a sample including 206 respondents. The respondents were at least 18 years old and they lived outside the area of the NP Tara. Descriptive statistics and bivariate analysis were used to identify the relationships between the socioeconomic variables and the perceptions of the local community members and visitors.

## 4. Results

### 4.1. WPI Values

The results of the study covering the 2007–2018 period, presented in Table 2, showed a low-to-moderate degree of water pollution in the Drina River. The WPI values recorded at the Bajina Bašta station were in the 0.45–1.23 range, corresponding to classes II (pure water) or III (moderately polluted water).

**Table 2.** WPI values, water classes at study sites in the 2007–2018 period.

Year	Bajina Bašta (Drina River)	
	WPI	Class
2007	0.78	II
2008	1.13	III
2009	1.23	III
2010	0.73	II
2011	0.68	II
2012	0.84	II
2013	0.74	II
2014	0.55	II
2015	0.96	II
2016	0.92	II
2017	0.85	II
2018	0.45	II

A comparison with other studies showed that similar results for water quality were obtained by Leščešen et al. [71], who analyzed the water quality status and the spatial and temporal trends along the Drina by applying seven WQI parameters to data from an eight-year public database (2004–2011). Based on the seven chemical parameters (pH, conductivity, BOD<sub>5</sub>, suspended solids, total oxidized nitrogen and CB) results of this study showed that water quality was very good at the Bajina Bašta station and the other three hydrological stations. The water of the Drina River was pure all along its course and it was completely suitable for exploitation and utilization [71]. Also, the results of the WPI analysis in the period 2006–2010 gave similar results for the Bajina Bašta station, while at the Ljubovija station the water was assessed as moderately polluted. When it came to

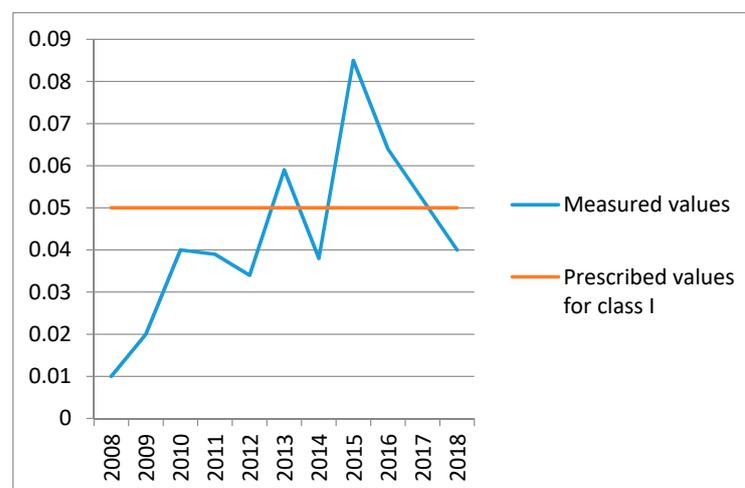
the influence of individual parameters on water pollution, increased values of S and CB were registered, which indicated moderate organic pollution [69]. According to the three monitoring cycles of 11 parameters (t, pH, EC<sub>w</sub>, TDS, Ca<sup>2+</sup>, Mg<sup>2+</sup>, K<sup>+</sup>, Na<sup>+</sup>, Cl, SO<sub>4</sub><sup>2-</sup>, SAR) on 12 selected sites in the Drina River basin during 2013, it was also concluded that water samples belonged to a class of water for drinking and irrigation [70].

Out of the 18 parameters used to calculate the WPI, the values of ten (DO, OS, pH, SS, CODMn, Ni, Cu, Cd, SO<sub>4</sub><sup>2-</sup> and PO<sub>4</sub><sup>3-</sup>) were always within the permissible values for class I. The values of two analyzed parameters (S and Mn) mainly belonged to class I, with occasional minor deviations. For example, in 2013, the measured value of the saprobic index (2.46) and manganese (0.063 mg/L) fell into class II. It is important to highlight that the value of Hg was about 0.1 and, according to the previous regulation, this was a permissible value for class I. According to the new regulation, the permissible value is 0.07, and therefore the Hg value may be classified as increased. The other five analyzed parameters that deviated more or less from the permissible values for class I, thereby affecting the WPI values, are shown in Table 3.

**Table 3.** Parameters above the prescribed values for class I at the Bajina Bašta station (Drina River).

Year	Biochemical Oxygen Demand (BOD5)	NO <sub>2</sub> <sup>2-</sup>	NH <sub>4</sub>	Fe	Coliform Bacteria (CB)
2007	II	I	I	II	I
2008	II	I	I	III	II
2009	I	I	I	I	II
2010	I	II	I	I	II
2011	II	II	I	I	II
2012	I	I	I	I	II
2013	I	II	II	I	II
2014	I	I	I	I	II
2015	I	I	II	I	II
2016	I	I	II	I	II
2017	I	I	II	I	II
2018	I	I	I	I	II

It can be concluded that the indicators of organic pollution (BOD5, NO<sub>2</sub><sup>2-</sup>, NH<sub>4</sub> and CB) had a significant impact on increased WPI values. With increased nutrient loads, eutrophication occurs, causing problems such as water quality deterioration, changes in the biotic population structure, oxygen depletion, etc. Generally speaking, the increased values of ammonium (Figure 2), as well as nitrite, indicated the organic pollution of the Drina River in the wider zone of NP Tara.



**Figure 2.** Values of ammonium in 2007–2018. (Source: The authors, based on the data of Republic Hydrometeorological Service of Serbia (RHSS)).

Based on an analysis of the WQI results for the Drina River in 2004–2011, Leščičen et al. [71] concluded that BOD5, total oxidized nitrogen and CB, as the indicators of organic pollution, had the greatest impact on water quality. High values of CB may indicate fecal pollution, which mainly originates from untreated sewage wastewater from Bajina Bašta [71]. Also, among the four hydrological stations where the BOD5 parameter was measured, the greatest values were recorded at Bajina Bašta. Our results, presented in Table 3, confirmed slightly increased values of BOD5 in 2007, 2008 and 2011, as well. However, water quality could be described as satisfactory according to this parameter, which was confirmed by the results of this study, as well as by the results of the abovementioned studies. The values of heavy metals (except Fe in 2007 and 2008) were generally within the permissible limits and their impact on pollution was relatively small.

#### 4.2. The Perceptions of the Local Population and the Visitors

As previously mentioned, we researched a sample of 210 randomly selected members of the local community. The socio-demographic profile of the respondents in the NP Tara was marked by the domination of women (52.9%) and the 30–39 age category (33.8%). Furthermore, 61.4% of the respondents living in the NP Tara had secondary education, whereas the respondents employed in tourism, or those with at least one family member employed in this activity, accounted for 20.5%.

To examine their perceptions of the different impacts of tourism on the environment, several specific impact variables were taken into consideration in relative terms—the mean value of the variable between 1 and 2.4 showed a negative attitude, 2.5–3.4 neutral, and 3.5 and higher revealed a positive perception (Table 4).

**Table 4.** Perceptions of the local population on the various influences of tourist activity.

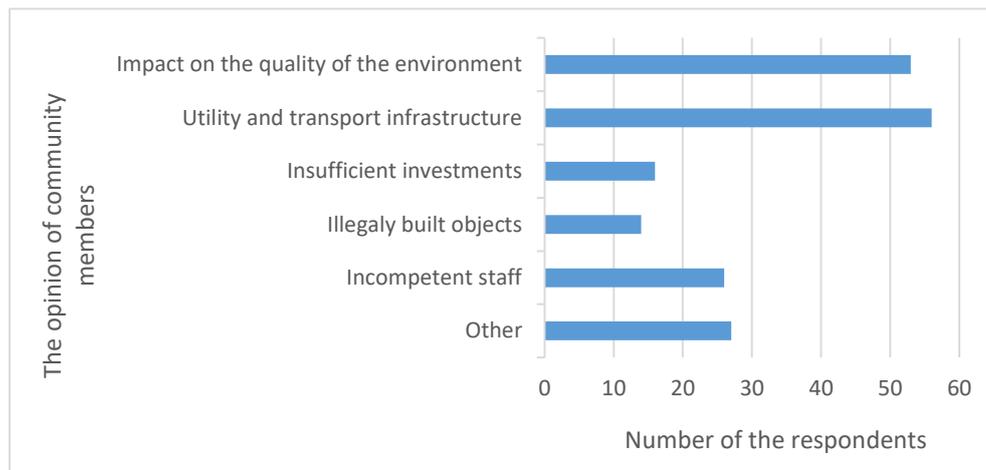
Variables	Mean	SD
Environment	3.4	1.1
Utilization of the natural resources needed for the local population (water, fish, etc.)	3.4	0.9
Infrastructure (roads, water supply, sewerage, garbage collection)	2.3	1.1
Opening new services (health, communal, etc.)	2.2	1.0

“How does tourism in your municipality/settlement affect the following activities?” Scale: 1-Significantly worsening; 2-Worse; 3-Does not affect (does not make a difference); 4-Improves (stimulates); 5-Significantly enhances (stimulates).

According to the results, the respondents believed that tourism did not affect (either positively or negatively) the environment. Also, they believed that tourism did not (either positively or negatively) influence the use of natural (primarily water) resources needed by the local community. As regards the perceptions of the activities related to environmental pollution, local people believed that tourism had a negative impact on the establishment of new utility services in their place of living. A similar opinion was also present regarding the impact of tourism on the communal infrastructure.

Bivariate statistical analysis was used in this research to explain the relationship between socio-demographic variables (gender, age, education, employment in tourism) and perceptions of local community members. The correlation analysis indicated a statistically significant correlation between the respondents’ opinions about the utilization of natural resources by tourism and the respondents’ ages ( $r = 0.16$ ). The one-way analysis of variance (ANOVA) revealed that the perception of the impact of tourism on the environmental quality was more negative among the older population (age group 50–59) than among younger respondents (30–39) ( $M = 2.94$  vs.  $M = 3.57$ ,  $F = 3.1$ ,  $p = 0.03$ ). The perceptions of the respondents with secondary education were more negative than the perceptions of the respondents with elementary education ( $M = 2.94$  vs.  $M = 3.47$ ,  $F = 3.6$ ,  $p = 0.03$ ).

In order to get an insight into the perceptions of the current problems of tourism development, residents were asked an open-ended question (“What is the most worrying thing about the development of tourism in your municipality?”). After finishing the survey, we defined the main categories of the answers (Figure 3).



**Figure 3.** The distribution of the community members' answers to the question "What is the most worrying thing about the tourism development in your municipality?"

Regarding the effects of tourism development in the NP Tara, the highest percentage of the respondents pointed out that they were the most concerned about the impact of tourism on environmental quality (53 respondents, 25.2%), highlighting the pollution of Lake Perućac with solid waste and the formation of frequent wild dumps on its coast as the main problem. They also emphasized the unregulated communal activities—waste removal, neglected public areas, wild landfills, incomplete and unfinished sewer construction, etc.

The sample of the visitors surveyed in the NP Tara included 206 respondents. The socio-demographic profile of the surveyed visitors was marked by the prevalence of women (NP Tara 64.1%) and the 30–39 age category (42.7%). The youngest age group (18–29) accounted for 25.2% of the sample. Visitors with secondary education prevailed (49.5%), while the percentage of visitors with a college (18%) or a university degree (32.5%) was significant. Visitors whose daily expenditures were USD 5–10 prevailed (57.8%) in the sample, as well as the tourists who had visited the NP Tara more than three times (58.7% of the sample).

Visitors' perceptions on the state of the environment in the NP Tara are presented in Table 5. According to the results, the visitors' opinions about the overall cleanliness of the NP Tara were positive. As regards the cleanliness of hydrological sites, beaches and wider coastal areas, the perceptions were neutral. The tourists who visited NP Tara claimed that garbage was not present in public areas within the national park and their overall opinion about the state of the natural environment in the national park was positive.

**Table 5.** Visitors' perceptions on the state of the environment in the national park.

Variables	Mean	SD
The cleanliness of the destination	4.2	0.9
The cleanliness of hydrological sites, beaches and wider coastal areas	3.3	1.1
The presence of garbage in public places	2.3	1.2
Environment state	3.7	1.0

The correlation analysis between socio-demographic variables (gender, age, education, daily consumption and repeated visits) and visitors' perceptions identified a statistically significant correlation between certain variables. A moderately negative correlation was found for the variables related to the perceptions of the cleanliness of hydrological sites, beaches and wider coastal areas and socio-demographic variables: age ( $r = -0.41$ ) and education ( $r = -0.39$ ). This means that the perceptions of older and more educated visitors regarding this issue were more negative. A weak negative correlation was determined for the same variable and the visitors' daily expenditures ( $r = 0.20$ ). The correlation analysis

also showed a weak statistically significant correlation between the perceptions of the presence of garbage in public places and the respondents' ages ( $r = 0.25$ ).

Tourists with lower daily expenditures (USD 5–10) had a more positive opinion of the overall cleanliness of the site than those with higher daily expenditures (over USD 10) ( $M = 4.34$  vs.  $M = 3.92$ ,  $F = 4.8$ ,  $p = 0.01$ ). As far as expenditures were concerned, identical relationships were identified for the perceptions of the cleanliness of hydrological sites, beaches and wider coastal areas ( $M = 3.62$  vs.  $M = 3.04$ ,  $F = 3.2$ ,  $p = 0.04$ ). Tourists with secondary education had a more positive perception of the cleanliness of hydrological sites, beaches and wider coastal areas than the visitors with university education ( $M = 3.61$  vs.  $M = 2.64$ ,  $F = 24$ ,  $p = 0.000$ ). In this case, a great influence of the tested social variable (education) was observed. The oldest visitors (50+) were more aware of the presence of garbage in public areas within the NP Tara than the youngest category of visitors (18–29) ( $M = 2.79$  vs.  $M = 1.94$ ,  $F = 4.5$ ,  $p = 0.005$ ). Similarly, the visitors with a university education were more aware of the presence of garbage in the NP than the tourists with a college education ( $M = 2.63$  vs.  $M = 2.14$ ,  $F = 3.3$ ,  $p = 0.04$ ).

## 5. Discussion

This study is the result of interdisciplinary research. In the first part, the water quality in the Drina River was analyzed using the WPI. In the second segment, the use of a survey and field research analyzed the opinion of the local residents and NP visitors on the state of the environment, and in part on water resources quality and pollution. Similar to some previous studies [65,79], our results showed that the local population's perceptions matched, to a certain degree, the measured water quality.

The water quality of the rivers in the wider zone of the NP Tara was generally satisfactory, which is important for the development of specific types of tourism that are related to environmental protection (nature tourism, ecotourism, geotourism, etc.). The calculated values of the WPI in the 2007–2018 period indicated low or moderate water pollution of the Drina River in the NP Tara sector. Based on these results, as well as the results of other studies that assessed the natural environment on Drina River flow [72,80], it can be concluded that the Drina River basin is a water-rich river basin characterized by untouched landscapes and a high level of biodiversity [72]. However, numerous analyses and the WPI results showed that water quality is affected by the discharge of solid waste into the Drina River basin and reservoirs in its basin (Uvac, Lim, Perućac), a large number of wild landfills in river valleys, large quantities of liquid waste that mixes with river water upstream (in Sjenica and Nova Varoš) due to inadequate sanitation, and the uncontrolled discharge of untreated wastewater in the wider zone of the NP Tara.

Principally, the underdeveloped and poorly regulated utility infrastructure in the wider area of the NP Tara is a major problem. In the Bajina Bašta municipality, within the NP Tara, wastewater is discharged directly into the watercourses without prior purification, through a partially regulated sewage system. A special problem highlighted in official documents on spatial development [81,82] is the pollution of Lake Perućac with municipal waste. Due to the presence of various pollutants in the upper sector of the Drina and its tributaries, Lake Perućac and the NP Tara zone are contaminated with several dozen cubic meters of floating waste a year, forming the so-called "floating dumps." The residents highlighted the importance of this problem in their answers to the open-ended question regarding the current problems connected to tourism development.

Another problem is groundwater pollution, which is a result of the inadequate use of agrochemicals and procedural waters from landfills. This situation is caused by the unplanned development of numerous weekend settlements (Kaluđerske Bare, Sokolina, Mitrovac, Osluša, Krnja Jela, Račanska Šljivovica, Oštra Stena, etc.), which are not supplied with appropriate infrastructure. This is particularly pronounced on the shores of Lake Perućac near the Klisura Derventa Nature Reserve, where more than 100 buildings were illegally built until 2012. They endanger the living species and the NP area in several ways: by endangering natural habitats of species and destroying the fauna, as well as through

the accumulation of communal solid waste, wastewater, destruction of the ambient values and tourist–recreational functions of the area. In the largest part of the park, the disposal of municipal waste from containers placed in public areas has been organized. However, there is no systematic waste management for household waste, which results in inadequate disposal of solid waste and the formation of landfills in the national park [82].

Industrial plants built in the cities in the Drina River basin also contribute to its pollution. Although some of the industrial plants have either ceased operation or are operating with minimum capacities (Maglić in Foča, Azot and Pobeda in Goražde, Varda and Terpentin in Višegrad, Kotroman in Mokra Gora and FAP in Priboj), they still discharge untreated or partially treated wastewater. According to the results of the List of Major Pollution Sources, the Poliester corporation in Priboj can be identified as a source of industrial waste pollution in the Drina River upstream from the NP Tara [83]. Finally, the influence of the Čehotina River, the Drina's right tributary, is also noteworthy. It is contaminated with rust from the former lead and zinc mine Šuplja Stijena near Pljevlja in Montenegro [69].

Compared to other types of pollutants (wastewater, the use of agrochemical resources and landfill waters), the pollution from the tourism sector is significantly lower, but not negligible. The accommodation and catering facilities in the territory of NP Tara do not have their own wastewater treatment systems. The only exception is the hotels owned by the Tara Military Institution at Kaluđerske Bare (Omorika and Beli Bor), where wastewater has been purified through a biodiversity system since 2004. The technological process used in the system is based on the presence of microorganisms, which help process fecal and other wastewaters into the quality water of class IIA (the water quality level of the Drina River). According to the "National Park Tara Management Plan for the period 2018–2027" [82], the significant expansion of tourist complexes and weekend settlements on Tara Mountain over the past 10 years, and the wastewater from these facilities are a growing threat to the quality of watercourses in the wider NP area.

Based on the spatial database of pollutants in the Drina River basin, Gajić et al. [84] concluded that industry, gravel pits, intensive agriculture and communal wastewater pollute the Drina River. Quarries and gravel pits lead to water pollution, as well as landscape change, riverbeds and turbidity. Also, Djordjevic et al. [85] concluded that apart from agriculture and urbanization, other factors have influenced the degradation of watercourses and their riparian areas in the Drina River basin, more specifically, undefined boundaries of water lands, pastures or agricultural households. In addition, it is important to emphasize that coastal erosion is present in the Drina basin, which leads to landscape degradation (lateral migration), socioeconomic (land loss, land-use change, economic losses) and geopolitical consequences [86].

Although the development of tourism may be beneficial for the environment for various reasons (better protection measures, growing awareness of the significance of environmental resources, etc.) [38], the surveyed community members, for the most part, did not agree that tourism in the NP Tara had positive effects on the environment. The local population identified the negative effects of tourism regarding the activities related to nature protection (establishing new communal services and improving the overall and communal infrastructure). In the literature, this was explained by the fact that residents' perceptions of the impact are affected by the distribution of benefits in the community, the stage of tourism development and the degree of participation in the decision-making process [78,87–90]. Accordingly, it can be concluded that tourism is an insufficiently developed and inadequately planned activity and that the role of the local community in its development is marginalized.

The results confirmed that age was a strong predictor of the population's perceptions of tourism's effects on the local environment. These findings appear to agree with some previous studies [44]. Compared to younger residents, the residents older than 50 perceived tourism's impact on the local environment as more negative. As they were mostly born in rural, non-urban areas, they probably observe tourism as a way of attacking nature, and

they may be more sensitive to environmental degradation. The analysis also showed that the perceptions of the respondents who were more educated were more negative. Compared to those with elementary education, residents with higher education have received more in-depth environmental education; consequently, they may be more concerned about the environment than the population with the lowest level of education. Unlike some previous studies [38], this study did not find a significant relationship between employment in tourism and the perceptions of residents.

Although a neutral perception of the cleanliness of hydrological facilities and beaches was observed, the overall opinion of visitors on the state of the environment was positive. Education and age were the most significant variables determining the visitors' perceptions in the NP Tara. It was found that older and more educated visitors had a more critical perception of the natural environment in this national park. In the literature, this was explained by the fact that higher education indicates higher expectations [91]; accordingly, if a protected area fails to meet the expectations, this will give rise to a critically oriented attitude. The results also show that tourists with higher daily expenditures had a more negative perception of the overall cleanliness of the destination. Unlike some previous studies [92,93], repeated visits did not affect tourists' perceptions.

## 6. Conclusions

The NP Tara, as well as other national parks, is an important tourist site due to its preserved ecosystems, intact nature and attractive buildings and phenomena. As some of the tourist activities are directly related to natural resources (hydrographical sites, forest ecosystems), their diversity and the fact that they are available in their original form may increase the attractiveness of a site. However, as national parks become attractive for various economic activities, the pressure on nature is constantly increasing, resulting in increased pollution and environmental degradation.

The main theoretical contribution of this research is to call attention to the unique link between the quality of natural resources and the people established in national parks from the aspect of rational use in tourism. This study advances knowledge about the state of hydrological resources, as an undoubted requirement for sustainable tourism development of protected areas. It also improves knowledge about the population's perceptions of the environment, as well as the predictors that condition the observations. As the outcomes of particular relationships examined in this research represent authentic findings on national park-related issues, the existing study also promotes remarkably the literature on this topic.

The water quality of the Drina River in the wider zone of the NP Tara is generally satisfactory, which is important for the development of specific types of tourism that are in accordance with environmental protection. The calculated WPI at the Bajina Bašta station for the 2007–2018 period was in the 0.45 (2018) to 1.23 (2014) range, corresponding to classes II (pure water) or III (moderately polluted water). Therefore, the water of the Drina River is completely suitable for exploitation and utilization. However, out of the 18 analyzed parameters, five parameters ( $\text{BOD}_5$ ,  $\text{NO}_2^{2-}$ ,  $\text{NH}_4$ , Fe, CB) deviated more or less from the permissible values for class I, thereby affecting the WPI values. Their increased values indicate the organic pollution of the Drina River in the wider zone of NP Tara. The most important sources of water pollution in the Drina River can be grouped as follows: (1) Industrial waste (especially from mines); (2) Agricultural waste; (3) Solid municipal waste (especially wild landfills) and a limited number of sanitary landfills and (4) Urban wastewater (including that from the tourism sector) due to lack of proper processing.

According to both the analysis of the WPI and the results of the survey conducted among the local population and tourists, the pollution from the tourism sector is significantly lower than the other types of pollution. Also, the analysis of residents' perceptions indicates that tourism has a poor impact on some segments of economic development related to environmental protection and the utilization of water resources. This is supported by the fact that compared to other activities, tourism is not the dominant industry in the municipality on whose territory the NP Tara is located (7% of the local population employed

in tourism in the municipality of Bajina Bašta) [69], so the impacts it creates, either positive or negative, are still smaller than the influences of more developed branches of the local economy. To make tourism a significant factor in the local economy, increased and targeted investments in tourism are needed. They should be supported by the government and local authorities, and special financial incentives for private individuals should be provided. The mentioned activities follow the philosophy and basic principles of sustainable tourism development, according to which it is necessary to provide stable employment, earning opportunities and social services to the host communities.

The results of the study also revealed that visitors' perceptions regarding the water quality in the Drina River were mostly in agreement with the measured water quality. Visitors agreed that the environment of the NP Tara was preserved, describing the destination as "clean," and the obtained WPI values confirmed this opinion—class II (pure water) prevailed almost throughout the analyzed period. Since the Drina River is used for swimming, nautical activities, sports and recreation, it is noteworthy that the values of the elements that influence water pollution are within the permissible limits. In general, despite the registered trend of the deterioration of water quality in the Drina River, its tourist function has not been disturbed yet, although this could happen in the future if the pollution trend continues.

The results of this study can be used for the future management of protected areas. To ensure the ecological control of tourism development, it is recommended to upgrade the communal infrastructure by constructing sewage systems and sewage treatment plants. Water purification devices must also be provided for industrial plants built in the cities in the Drina River basin, as well as for tourist facilities within the national park. The *Spatial Plan for the Special Purpose Area of the NP Tara* [48] highlights the following factors as the underlying weaknesses of the area: environmental degradation due to poorly developed utility services, poor functioning of landfills that do not follow the modern principles of municipal waste disposal; an insufficient and inadequate knowledge base in the community to create the models of proper ecological behavior. In line with this, it is necessary to define developmental priorities and future activities, but this requires significant initial intervention on the part of the government through increased investment.

Environmental problems are increasing in scope and it is necessary to focus greater attention on each specific problem. In line with this, our study confirms that the investigation of tourist perceptions can provide valuable data, which may be used together with traditional monitoring in national parks. Information coming from perception analysis can be useful for implementing specific visitor management strategies and simulation models. This study also highlights the internal threats to sustainable tourism from the perspective of the residents and offers the opportunity to take action. In order to ensure a better understanding of this topic, we propose the implementation of comparative trans-border research studies that will build upon the outcomes of this research.

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