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DEPARTMENT OF GEOGRAPHY, TOURISM AND HOTEL MANAGEMENT

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Quantifying Nationality Bias in Social Media Data on Different Platforms for Visitor Monitoring in Nikko National Park, Japan

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KEYWORDS

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Nature-based tourism
Representativeness
Sampling bias
Social networking service
Spatial visitor distribution
Twitter

ABSTRACT

Geotagged social media data have been used widely for visitor monitoring in protected areas. The data might, however, over or underestimate visitors from specific countries due to nationality bias, i.e., differences between nationality of actual visitors versus those visitors who post on social media. This study aimed to quantify nationality bias in social media data for visitor monitoring. We conducted a questionnaire survey in Nikko National Park, Japan. Questions covered the nationality of visitors and their usage of social media, and other visitor attributes and behavior. Foreign visitors had significantly different attributes and behaviors compared to Japanese. Non-Japanese Asian visitors were overrepresented in Instagram and Facebook data. In comparison, the X platform was more representative of all visitors. Nationality bias in different platforms needs more attention and further study in different areas.

Introduction

Nature-based tourism in protected areas has grown worldwide in recent years. It has been recognized that nature-based tourism can improve human health and well-being, generate revenue for nature conservation, contribute to local economies, and foster local and indigenous identity (Winter et al., 2020). Visitors can enjoy a wide range of activities by taking advantage of the unique natural features of each protected area. Meanwhile, excessive use of natural areas can result in their degradation or loss and a subsequent decrease in visitor satisfaction (Luque-Gil et al., 2018). It is necessary to carry out proper visitor monitoring and management to achieve quality experiences for them without damaging nature resources.

Data on visitors and their behavior in protected areas are crucial for monitoring and management, but these data are often not easy to collect. Recreational activities in protected areas vary greatly depending on the attributes of visitors, such as age, gender, and size of party (Batra, 2009). Field surveys are commonly used to investigate visitors' attributes, as well as their purpose and behavior, but data collected in this way have limited spatiotemporal res-

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olution due to insufficient budgets and human resources (Cessford & Muhar, 2003; Chua et al., 2016).

A possible solution is to use data that can be obtained from social media. Geotagged photos and messages posted on social media by visitors have been considered as particularly useful sources of information because they are generated on site. An increasing number of attempts have been made to collect visitor information with high spatiotemporal resolution from geotagged social media posts (Sotiriadis, 2017). Previous studies using geotagged data on social media have analyzed the spatial distribution of visitors (Kim et al., 2019), balance between demand and supply of nature-based cultural services (Yoshimura & Hiura, 2017), the activities and interests of visitors (Heikinheimo et al., 2017), and the satisfaction of visitors with their nature experiences (Lu & Stepchenkova, 2012).

A common issue pointed out in previous studies that used social media is data bias in posters' attributes. Examples of possible data bias include an emphasis on younger people, who are more likely to use social media (van Zanten et al., 2016), gender differences in posting frequency (Keeler et al., 2015), and differences in posting frequency based on the distance from home (Wood et al., 2013). However, even though we can recognize the existence of bias in social media data, the bias may be difficult to quantify because posters often do not disclose their personal information due to privacy concerns. It is therefore challenging to determine who and what the social media data represent and to interpret this data in a reliable way (Fischer, 2012).

The nationality of visitors is an essential sociodemographic characteristic for any social media analysis, as it is often one of the parameters examined for more in-depth analysis (Heikinheimo et al., 2022). For example, this information is crucial for separating locals from visitors in tourism research (García-Palomares et al., 2015). Visitor nationality also merits attention in that nationality differences may result in bias when exploring visitor behaviors on social media if a specific nationality group is more likely to share information than other groups (Sinclair et al., 2020).

The present study focused on nationality bias, i.e., differences between the nationality of actual visitors versus the nationality of those visitors who post on social media. Nationality bias can arise due to significant differences in the use of social media from country to country (including the proportion of the population using social media) (Blank, 2017). Differences between countries in culture and values can greatly influence visitor behavior. For instance, domestic and foreign travelers can take different travel routes to destinations and prefer different types of activities (Chua et al., 2016), and people from Asian and non-Asian countries often behave differently on their trips (Vu et al., 2015). Thus, social media data may over or underestimate the behavior of visitors from specific countries or regions because of nationality bias.

However, nationality bias is not fully understood. Few studies have explicitly considered it to help understand visitor behavior in protected areas. Sinclair et al. (2020) estimated the residences of visitors to several national parks in Germany using their geotagged photos on Flickr and compared the findings with onsite survey data. They found that foreigners accounted for a significantly higher percentage as a share of Flickr posters than of actual visitors. This previous finding is informative, despite being limited to specific geographical areas and specific cultures. More case studies are needed, particularly in areas where the majority of visitors are from Asian countries or other countries outside of Europe and the Americas. People from Asian and non-Asian countries differ in their use of social media (Brian, 2023) and behavior on their trips (Vu et al., 2015). Furthermore, given that the number of travelers from Asia has increased in the international tourist trade (World Tourism Organization, 2019), for practical reasons it is important to understand nationality bias in Asian countries, which attract Asian tourists with relative ease due to geographic proximity.

This study examined one protected area in Japan that attracts many visitors from Japan and overseas (the latter especially from Asia). Our objective was to quantify possible nationality bias in social media data, in order to improve a general understanding of this issue and the feasibility of using social media for visitor monitoring and management in protected areas. Japan has made inbound tourism a pillar of its economic growth strategy, and in particular has featured national parks as important attractions. Given that the numbers of foreign tourists were on a rising trend in national parks as well as the country as a whole (Japan Tourism Agency, 2020a), it is also crucial in this national context to understand nationality bias in social media data.

Although Twitter was renamed X at the end of July 2023, this paper uses the name as it was when our survey was conducted.

Data and Methods

Study area

Our study site was the Oku-Nikko area of Nikko National Park in Tochigi Prefecture (Figure 1). It was designated a national park in 1934 and extends over three prefectures: Tochigi, Gunma, and Fukushima Prefectures. The park's total area is 114,908 ha, of which private lands occupy 27.1%. It is one of the most popular national parks in Japan, ranking fourth in visitor numbers among all national parks in 2019 (Ministry of the Environment, 2023). Factors for its popularity include easy access from Tokyo, attractive shrines and temples at this World Cultural Heritage site, and outstanding nature to enjoy.

The Oku-Nikko area is located in the southwestern part of Nikko National Park, and its average elevation is about 1,400 m above mean sea level. This part of the national park contains well-known wetlands, waterfalls, lakes, and rich fauna and flora, making it a popular area for hikers. It is especially full of tourists during the fall when the autumn foliage is in full color. Since the area is a principal destination for nature-based tourism within the park, we selected it as our study site.

The study area can be classified into three zones in terms of their attractiveness and visitor characteristics. The southeastern zone is crowded with mass tourists

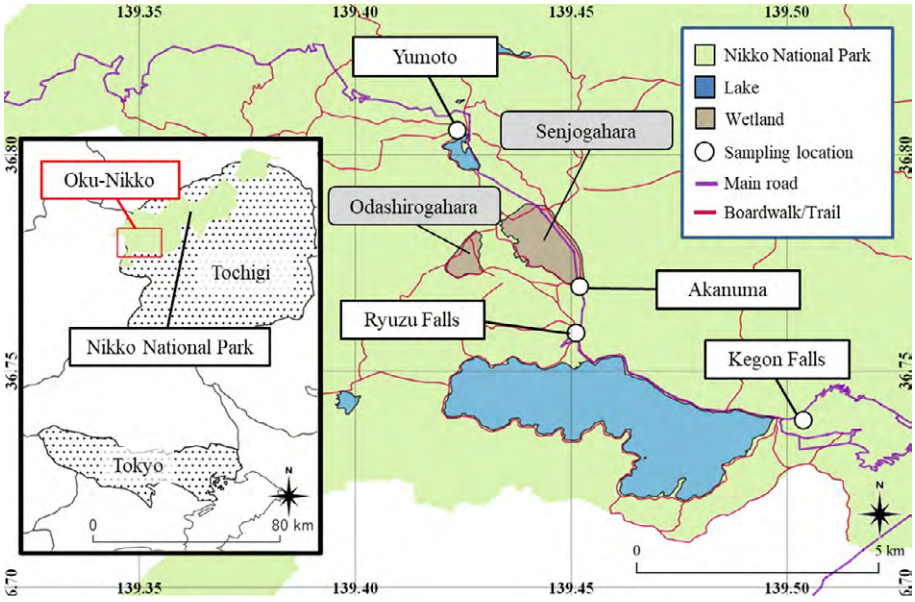

Figure 1. Sampling locations in the Oku-Nikko area of Nikko National Park, Japan

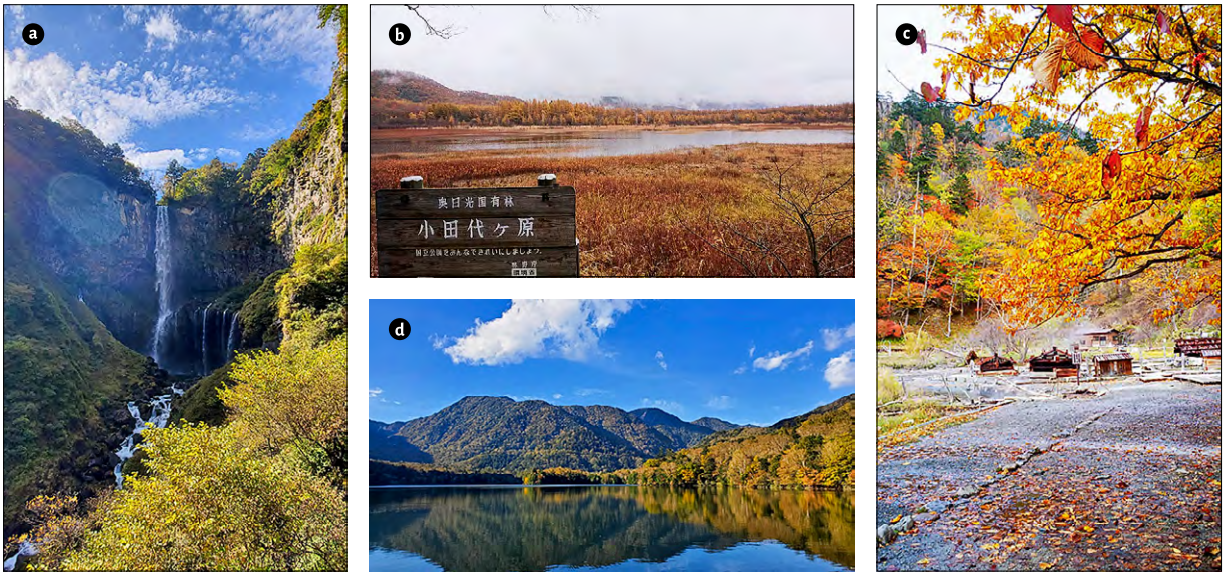

Figure 2. Typical scenery in the Oku-Nikko area of Nikko National Park, Japan:
(a) Kegon Falls, (b) Odashirogahara, (c) Yumoto, and (d) Lake Yunoko

mainly attracted to see Kegon Falls (Figure 2a), a nationally famous waterfall, and benefits from relatively easy access from the World Cultural Heritage site "Shrines and Temples of Nikko," which is east of the Oku-Nikko area. The central zone is characterized by marshes listed under the Ramsar Convention as "Oku-Nikko-shitsugen," including Senjogahara and Odashirogahara (Figure 2b), and visitors enjoy hiking there. The northern zone centers on a hot springs resort, named Yumoto (Figure 2c), next to Lake Yunoko and surrounded by mountains (Figure 2d), which attracts overnight visitors who enjoy hiking and climbing.

Questionnaire survey

We conducted a questionnaire survey of visitors at the following four locations in the Oku-Nikko area from October 25 (Fri) through 28 (Mon) 2019: Kegon Falls in the southeastern zone (hereafter Kegon Falls), a primary starting point for hikes around the wetlands in the central zone (Akanuma), the hot spring resort in the northern zone (Yumoto), and a famous waterfall, named Ryuzu Falls, located in between the central and southeastern zones (Ryuzu Falls). These four locations attract a diverse range of visitors. As soon as we finished one interview, we immediately approached the next visitor (or group) that passed and confirmed the willingness of respondents to participate in the survey (i.e., informed consent was secured).

Questions asked of visitors covered their nationality and usage of social media, including what social media platforms they used, whether or not they posted on social media to share their travel experiences, and whether or not they used geotags when doing so. We also investigated other basic visitor attributes and behavior, including gender, age, size of party, means of transportation, length of stay, and places visited within the Oku-Nikko area. The survey was available in both Japanese and English, and targeted all visitors over the age of 13.

Our survey period was right before the COVID-19 pandemic started. Since the number of international visitors to Japan dropped during the pandemic, we used 2019 data to adequately detect nationality bias.

Resampling of collected data

When conducting surveys at multiple locations with different levels of popularity, sampling should be done according to the spatial distribution of the number of actual visitors at those locations, in order to avoid over or underestimating characteristics of some locations. In our survey, Kegon Falls was crowded with mass tourists and appeared to have the largest number of visitors among the four sampling locations. However, the number of respondents at Kegon Falls was actually lower than at other locations (Table 1), which indicates that the characteristics of visitors to Kegon Falls would be underestimated in our dataset. The dataset should be resampled with reference to other visitor count data, but detailed reference visitor data such as the number of visitors in different segments of a natural area are generally not available.

We estimated the relative ratio of actual visitor numbers at the four sampling locations using two parameters: the number of visitors who actually posted geotagged tweets (on Twitter) around each of the locations in October 2019, and the percentage of respondents who answered that they usually posted their travel experiences with geotags (on Twitter). The reason why we used Twitter is as follows. First of all, the number of posts on social media generally has strong correlations with actual visitor numbers in national parks (Wood et al., 2013). Among major platforms, Instagram and Facebook had a large number of users in the world and a great number of posts about nature (Hausmann et al., 2018). These platforms, however, had limited application in research, probably because of restrictions on data access (Ghermandi & Sinclair, 2019). Twitter and Flickr were less restrictive, and many studies had applied data from these platforms to visitor monitoring in protected areas (Ghermandi & Sinclair, 2019). Flickr, however, was rarely used in Japan, whereas the number of Twitter users was larger than that of even Instagram or Facebook in Japan (GlobalWebIndex, 2020). We therefore considered Twitter as the best social media platform for the resampling.

We collected all publicly available geotagged posts on Twitter within the bounding box area defined by 36.698186 N, 36.834750 N, 139.318670 E, and 139.528918 E, which is identical to the map area shown in Figure 1, from October 1 to 31, 2019, using the Twitter API. As a result, we obtained 422 geotagged posts after excluding irrelevant posts, such as weather and earthquake news. We counted how many tweets were posted within a 200 m radius of each sampling location using QGIS version 3.8.0. If the same person posted more than once at the same location on the same day, we counted the posts as one post.

We estimated the relative ratio as shown in Eq. (1) and calculated the size of resamples at each sampling location as shown in Eq. (2) and Table 1,

$$RR_i = \frac{Ti \cdot \left(\frac{S_i}{s_i}\right)}{T_{Kegon} \cdot \left(\frac{S_{Kegon}}{s_{Kegon}}\right)} \quad (1)$$

$$RS_i = S_{Kegon} \cdot RR_i \quad (2)$$

where i is codes for sampling locations (i.e., Kegon Falls, Akanuma, Yumoto, or Ryuzu Falls), RR is the ratio of visitor numbers at location i to those at Kegon Falls, S is the number of samples collected (i.e., the number of total respondents) at location i, s is the number of respondents who answered that they usually posted their travel experi-

Table 1. Result of resampling the dataset collected in the Oku-Nikko area in October 2019

Sampling location	Total sample (*S*)	Tweeting sample (*s*)	Tweeter (*T*)	Relative ratio (*RR*)	Resample (*RS*)
Kegon Falls	243	19	55	1	243
Akanuma	371	27	31	0.61	147
Yumoto	231	14	10	0.23	57
Ryuzu Falls	340	28	25	0.43	105

*Total sample (**S**) is the number of total respondents at each of the sampling locations; Tweeting sample (**s**) is the number of respondents at each of the sampling locations who answered that they usually posted their travel experiences with geotags on Twitter; Tweeter (**T**) is the number of visitors who posted geotagged tweets around each of the sampling locations; Relative ratio (**RR**) is the estimated relative ratio of actual visitor numbers among the sampling locations; and Resample (**RS**) is the number of resamples at each of the sampling locations (cf. Eq (1) and (2)).*

ences with geotags on Twitter at location *i*, *T* is the number of visitors who posted geotagged tweets around location *i*, and *RS* is the number of resamples at location *i*. Given that Kegon Falls appeared to have the largest number of visitors among the four locations, it was treated as a reference when calculating the relative ratio.

We randomly extracted respondents of the estimated number (*RS*) at every location and built a new dataset. This resampling was repeated three times to test whether the attribute characteristics of extracted respondents varied at every resampling. The statistical analysis described in the next section was applied to the three resampled datasets for this test. We found that the characteristics of visitor attributes did not generally differ between the three datasets (see Results for details), so we randomly chose one of the datasets for further analysis.

Statistical analysis

First, we compared visitor attributes (except nationality) and behaviors between all visitors and visitors posting with geotags on social media, and between all visitors and visitors of each nationality group, in order to characterize these different groups of visitors. Then, we analyzed whether the ratio of visitors posting with geotags on social media to all visitors differed by nationality, to test for nationality bias in social media data. To simplify analysis and interpretation of results, we considered social media posters to be only those visitors who used Twitter, Instagram, or Facebook platforms, which accounted for 98.0% of all the respondents who shared their experiences with geotags on social media. Our nationality classifications were Japan, Asia (excluding Japan), and non-Asia (88.0% from Europe and North America, the rest from Australia, New Zealand, and Chile), which is similar to the classification used by Vu et al. (2015) for visitors to Hong Kong to examine the behavior of tourists with different profiles. Asia in our classification included countries defined by the United Nations as East Asia, South Asia, Central Asia, West Asia, and Southeast Asia. We performed the analysis of means (ANOM) or Fisher's exact test for all comparisons at a 5% significance level. All statistical analyses were conducted using JMP version 15.

Results

Visitor attributes

We found no significant differences in gender, group size, and length of stay between all visitors and visitors posting with geotags on social media regardless of the platforms (Table 2). On the other hand, the age of visitors posting on any platform of social media tended to be younger than that of all visitors, and fewer visitors posting on Instagram or Facebook used cars for traveling and they tended to be first-time visitors compared to all visitors.

The visitor attributes of all visitors were generally similar to those of Japanese visitors, although some statistical differences were detected, probably because of the large sample size. Gender did not differ due to nationality, but other attributes differed between all visitors and visitors from Asia or outside Asia: age of foreign visitors was younger; the group size of Asian visitors tended to be larger, and that of visitors from the outside Asia tended to be smaller; Asian visitors more often stayed overnight; and most of the foreign visitors did not use cars and were first time visitors.

These results were obtained from all three resampled datasets with only slight differences (Table 3). We assumed that the characteristics found in only one dataset (i.e., length of stay for Facebook and frequency of visit for Twitter) were produced by a fluctuation due to resampling, and excluded them from consideration. The result in Table 2 is based on dataset C in Table 3, which we randomly chose.

Table 2. Differences in visitor attributes between all visitors and visitors posting with geotags on social media, and between all visitors and visitors of each nationality group in Oku-Nikko, Japan

Attribute	All visitors (*n* = 552)	Social media platform used						Nationality group					
		Twitter (*n* = 46)		Instagram (*n* = 80)		Facebook (*n* = 62)		Japan (*n* = 483)		Asia (*n* = 44)		Non-Asia (*n* = 25)	
Gender													
Male	61.6%	69.6%		55.4%		56.1%		63.3%		51.3%		45.8%	
Female	38.4%	30.4%		44.6%		43.9%		36.7%		48.7%		54.2%	
Age group													
10s	1.5%	6.5%		5.0%		4.8%		1.5%		2.3%		0.0%	
20s	18.8%	43.5%		41.3%		29.0%		17.0%		25.0%		44.0%	
30s	12.9%	17.4%	*	25.0%	*	25.8%	*	10.1%		36.4%	*	24.0%	*
40s	14.9%	13.0%		15.0%		17.7%		14.3%		20.5%		16.0%	
50s	20.8%	13.0%		10.0%		14.5%		22.6%		9.1%		8.0%	
≥60s	31.2%	6.5%		3.8%		8.1%		34.6%		6.8%		8.0%	
Group size													
1	14.5%	10.9%		12.5%		8.1%		12.8%		15.9%		44.0%	
2	59.6%	60.9%		57.5%		59.7%		62.1%		40.9%		44.0%	
3	10.5%	8.7%		6.3%		6.5%		11.4%		6.8%	*	0.0%	*
4	7.6%	8.7%		11.3%		14.5%		6.8%		13.6%		12.0%	
≥5	7.8%	10.9%		12.5%		11.3%		6.8%		22.7%		0.0%	
Transportation													
Car	72.6%	71.7%		55.0%	*	53.2%	*	81.4%	*	15.9%	*	4.0%	*
Other	27.4%	28.3%		45.0%		46.8%		18.6%		84.1%		96.0%	
Length of stay													
Day visitor	55.4%	58.7%		47.5%		45.2%		57.6%	*	38.6%	*	44.0%	
Overnight visitor	44.6%	41.3%		52.5%		54.8%		42.4%		61.4%		56.0%	
Frequency of visit													
First-time visitor	26.5%	34.8%		45.0%	*	45.2%	*	19.1%	*	72.7%	*	88.0%	*
Repeat visitor	73.6%	65.2%		55.0%		54.8%		81.0%		27.3%		12.0%	

** indicates a significant difference from the mean of all visitors at a 5% significance level. Among the visitor attributes surveyed, only gender had some missing values, and its sample size differed: n = 74 for Instagram, n = 57 for Facebook, n = 477 for Japan, n = 39 for Asia, and n = 24 for non-Asia.*

Table 3. Differences in analysis results between three resampled datasets

Attribute	Social media platform used			Nationality group		
	Twitter	Instagram	Facebook	Japan	Asia	Non-Asia
Gender						
Age group	A, B, and C	A, B, and C	A, B, and C		A, B, and C	A, B, and C
Group size					A, B, and C	A, B, and C
Transportation		A, B, and C	A, B, and C	A, B, and C	A, B, and C	A, B, and C
Length of stay			A	B and C	B and C	
Frequency of visit	B	A, B, and C	A, B, and C	A, B, and C	A, B, and C	A, B, and C

A, B, and C indicate different datasets. The appearance of the character(s) in each cell indicates that a significant difference from the mean of all visitors was detected at a 5% significance level when using the corresponding dataset(s) (see Table 2 for the result using dataset C).

Visitor behavior

We found that visitors posting with geotags on Instagram or Facebook tended to visit historical buildings and recreational facilities more often (Table 4). As we found with visitor attributes (described above), the behavior of all visitors was generally similar to that of Japanese visitors. Asian people visited historical buildings and recreational facilities more often and wetlands less often. Visitors from outside Asia also visited historical buildings more often. Although they appeared to visit wetlands less often, no statistical difference was found, a factor probably influenced by the small sample size.

Nationality bias

Rates of posting with geotags on Twitter in all nationality groups were not significantly different from the average of all visitors (Figure 3). On the other hand, Asian visitors posted more with geotags on Instagram and Facebook, whereas Japanese visitors posted less on these platforms than all visitors.

Table 4. Differences in visitor behaviors between all visitors and visitors posting with geotags on social media, and between all visitors and visitors of each nationality group in Oku-Nikko, Japan

Place visited	All visitors (n = 552)	Social media platform used						Nationality group					
		Twitter (n = 46)		Instagram (n = 80)		Facebook (n = 62)		Japan (n = 483)		Asia (n = 44)		Non-Asia (n = 25)	
Waterfalls	80.6%	87.0%		87.5%		80.7%		78.9%	*	93.2%		92.0%	
Wetlands	40.6%	43.5%		46.3%		45.2%		42.7%	*	31.8%	*	16.0%	
Lakes	36.8%	28.3%		38.8%		40.3%		35.2%		47.7%		48.0%	
Historical buildings	21.9%	30.4%		42.5%	*	45.2%	*	17.8%	*	54.6%	*	44.0%	*
Recreational facilities	19.6%	26.1%		31.3%	*	37.1%	*	16.8%	*	50.0%	*	20.0%	
Other nature spots	4.0%	4.4%		2.5%		6.5%		3.9%		6.8%		0.0%	

** indicates a significant difference from the mean of all visitors at a 5% significance level*

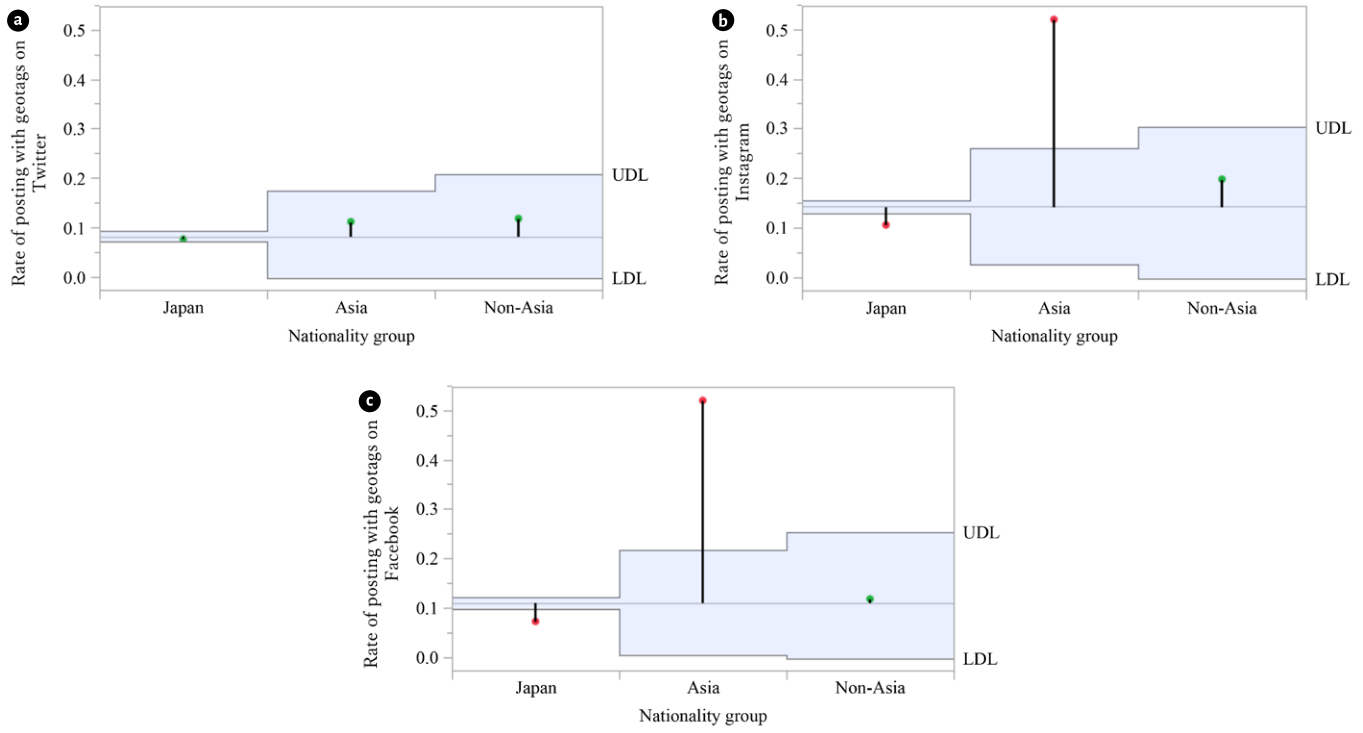

Figure 3. Differences in the rates of posting with geotags on Twitter (a), Instagram (b) and Facebook (c) between all visitors and visitors of each nationality group. UDL, upper decision limit; LDL, lower decision limit. The line in the middle of the blue area shows the average of all visitors. The percentages out of the range from LDL to UDL, shown in red, indicate that the values are significantly different from the average value of all visitors at a 5% significance level

Discussion

Visitor attributes

Many foreign visitors cannot drive a car by themselves because they do not have a driver's license in Japan and tend to use public transportation. The means of transportation therefore largely differed between domestic and foreign visitors. Most Japanese visitors in our survey were repeat visitors, which is consistent with a previous visitor survey conducted in the Oku-Nikko area (Miyasaka et al., 2018), whereas foreign visitors were more likely to be first time visitors. It is obvious that international trips are not easy to repeat in terms of time and cost compared to domestic trips. Liao et al. (2019) also reported that people who frequently travel abroad tended to visit places they have never visit before. Foreign visitors and all visitors or Japanese visitors had opposite patterns for these two attributes, i.e., means of transportation and frequency of visit, and these large differences probably made differences in these attributes of Instagram and Facebook posters, a relatively large number of whom were foreigners. On the other hand, even though visitors from Asia or outside Asia had statistically significant different patterns of group size and length of stay compared to all visitors, the degree of differences would not be large enough to influence those attributes of social media posters. The result that visitors posting on social media were younger compared to all visitors regardless of the platforms would be just a general trend (Heikinheimo et al., 2017; Hausmann et al., 2018), rather than the influence of foreign visitors, who were also younger than all visitors. Regarding group size, Asian visitors were more likely to come in a group of four or more, while visitors from outside Asia were more likely to visit alone. A study of foreigners visiting Shirakawa-go, a popular World Cultural Heritage site in Japan, also showed that many Asian tourists were in groups but that the majority of non-Asian tourists were alone (Ichikawa et al., 2016). The attribute patterns of foreign visitors found in this study are generally consistent with the results of an official nationwide survey of foreign tourist behavior in Japan (Japan Tourism Agency, 2020b), which showed that most foreign visitors to Japan used public transportation, the first time visit was the largest category of visitation frequency of foreigners, and non-Asian visitors tended to be alone compared to Asian visitors.

Visitor behavior

Visitors posting on Instagram and Facebook and foreign visitors, particularly Asian visitors, were more likely to visit historical buildings and recreational facilities. These places were located in the southeastern zone of the study area. Since this zone is relatively easily accessible from the World Cultural Heritage site of the park, many visitors to the zone just stop in and tend to be first time visitors. Many foreign visitors appear to fall in the category of such visitors. Furthermore, wetlands, including a popular but low accessibility wetland, were less visited by foreign visitors, unlike other natural places such as waterfalls and lakes, probably because major waterfalls and lakes are all more accessible, being located near a main road. On the other hand, Japanese visitors tended to focus on natural landscapes including wetlands, implying that repeat visitors might be more attracted by (deeper) nature than artificial places. For example, Miyasaka et al. (2018) reported that about 90% of hikers in the Oku-Nikko area were repeat visitors. These results are consistent with previous findings that foreign tourists were spatially concentrated in major sightseeing spots compared to domestic travelers (Ghermandi et al., 2020; Muñoz et al., 2019).

Nationality bias

Instagram and Facebook users worldwide have been higher in number than Twitter users, but the reverse is true in Japan, where Twitter was the most popular platform in 2019 (GlobalWebIndex, 2020). This difference could explain the nationality bias found only in Instagram and Facebook posters in the area. Although we used data gathered in 2019, Twitter (now X) remains as the most popular platform in Japan (Kemp, 2023), while the number of inbound tourists in Japan has recovered in 2023 to the same level as before the COVID-19 pandemic (Japan National Tourism Organization, 2023). Thus, we believe that our findings are still relevant.

Nationality bias can be expected to vary depending on the status of use of social media, which can differ from country to country. In German national parks, for example, Sinclair et al. (2020) reported that visitor counts derived from Flickr and onsite survey data were highly correlated, but that those from another social media platform, VKontakte, and the onsite survey data were not significantly correlated. This was due to the characteristics of VKontakte being particularly used by Russian speakers, which meant low representativeness of all visitors to German national parks. In addition to such a difference in the usage of social media, nationality bias can also be affected by different visitation rates of foreigners within and between countries. For instance, the capital city had more foreign visitors than other areas in Serbia (Kalinić and Vujičić, 2019), and the dependency of the tourism market on international travelers in the United States was lower than in the EU (Stankov et al., 2018). Considering these differences between countries and subregions in social media usage and inbound tourism conditions, further case studies are needed to elucidate nationality bias and to improve the feasibility of using social media for visitor monitoring and management.

Although there has been little research to date on nationality bias in social media data, Sinclair et al. (2020) found that Flickr data overrepresented international visitors to German national parks, who primarily came from the Netherlands, the United Kingdom, and the United States. The present study demonstrated that data on Facebook and Instagram, but not on Twitter, overestimated Asian visitor numbers and their behavior in a Japanese national park. Ours is the first case study to identify nationality bias in Asia comparing the three major social media platforms. Our results suggest that care is required when using popular worldwide platforms for visitor monitoring, as those platforms do not capture visitors from all geographic regions equally (Heikinheimo et al., 2022).

Foreign visitors might be more likely than Japanese visitors to share their travel experiences using geotags, and this might strengthen the nationality bias we found. The Ministry of Internal Affairs and Communications (2020) reported that people in Japan were more concerned than in other countries, such as China, Germany, and the United States, about providing personal data (including location information) to companies via web services. Also, in general, international visitors tended to see their new experience in a foreign country as more special than domestic visitors (Ghermandi & Sinclair, 2019). This tendency might drive their desire to record details of their travels to aid memory and to share with friends and family. Geotags facilitate that recording of details. Such psychological factors might boost posting rates by foreign visitors using geotags and reinforce nationality bias.

Limitation and implication

Although Rusdi et al. (2019) showed that there was no significant difference between Asian and non-Asian visitors to Indonesia in the rates of posting on social media while traveling, our study detected nationality bias only in Asian visitors. Our results might be influenced by our small sample size of non-Asian visitors. This is a limitation of our study and is due to the resampling of our original dataset. If we had checked the number of Twitter posts in four sampling locations (Tweeter (*T*) in Table 1) before conducting the questionnaire survey, we could have collected samples that more closely approximated the actual distribution of visitors (estimated by Relative ratio (*RR*) in Table 1), and could have minimized the reduction of sample size by resampling (Total sample (*S*) minus Resample (*RS*) in Table 1). This indicates, however, that checking the number of social media posts at multiple sampling locations beforehand can help collect balanced samples even where actual visitor distribution is unknown. Furthermore, our study suggests that nationality bias can be confirmed using a simple questionnaire survey on visitor nationality and social media usage, combined with analysis of the distribution of social media posts at the sampling locations. This is a theoretical and practical implication for consideration for future research and park management.

Conclusion

The present study quantified possible nationality bias in social media data for visitor monitoring in the Oku-Nikko area of Nikko National Park, Japan. Our result showed that visitors posting with geotags on Instagram and Facebook and visitors from Asia (excluding Japan) and outside Asia (particularly Europe, America, and Oceania) generally had similar patterns of visitor attributes, except group size. The foreign visitors, particularly Asian visitors, also had similar patterns of places visited compared to visitors posting with geotags on the two platforms. These attribute and behavior patterns were different from the patterns of all visitors, most of whom were Japanese (87.5%). In contrast, visitors posting with geotags on Twitter did not significantly differ in visitor attributes or behaviors from all visitors, except in terms of age. In addition, the rates of posting with geotags on Instagram and Facebook were much higher for Asian visitors and lower for Japanese visitors, compared to all visitors, whereas the rates of posting with geotags on Twitter did not differ among nationality groups. These results indicated that foreign visitors had different characteristics compared to all visitors or Japanese visitors and that in particular, Asian visitors and their behavior would be overestimated based on Instagram and Facebook data.

Our results suggest that in Japan, compared to Instagram and Facebook, Twitter would be more representative of all visitors in areas where most of the visitors are domestic (Japanese). Nationality bias, however, can vary in different areas due to varied social media usage, including platform preferences, and foreigners' visits. More case studies are anticipated in the future, and it is our hope that this study's approach to quantify nationality bias can contribute to them.

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Derivation of Geographical Marginalization Index of Bosnia and Herzegovina using GIS Multicriteria Decision Analysis

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KEYWORDS

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ABSTRACT

Across Europe marginalization has been highlighted as an object of important political concern. In the area of Central Europe and the Balkans, the problem of marginalization has not been sufficiently researched. This particularly applies to the Bosnia and Herzegovina (BiH). Using the GIS multicriteria decision analysis a composite index of geographical marginalization (G_{MAR}) was created. Marginalization is analyzed as a multidimensional concept using the 4 groups with a total of 40 criteria. Spatial patterns were detected from extremely marginalized to extremely non-marginalized regions. The G_{MAR} indicates the existence of regional disparities in BiH. The high degree of marginalization, especially those in the border sector, alerts the implementation of the demarginalization measures.

Introduction and Background

The occurrence of marginalization can be closely related to **socio-spatial polarization** of specific region or country. This is important for those areas that are experiencing or have recently experienced **social**, **economic** or **political** transformation (Madzevic et al., 2013; Mikuš et al., 2016). Bosnia and Herzegovina (BiH) best exemplify this example.

The definitions of **marginality** are numerous, diverse and subject to interpretation (Cullen & Pretes, 2000; Gurung & Kollmair, 2005; Abebaw & Admassie, 2014). However, they have one thing in common. Marginality is regarded as **complex** issue that frequently lies at the root of **poverty** and well-being of people (Graw & Husmann, 2014; Chieffallo & Palermo, 2022) or is closely connected to economic power of regions (Šiljeg et al., 2016).

Since uniform definition of marginality does not exist (Mikuš et al., 2016) in this paper one of the most widely accepted definitions is used where Gatzweiler et al., (2011, 3) are defining marginality *as an involuntary position and condition of an individual or group at the margins of social, political, economic, ecological, and biophysical systems, that prevent them from access to resources, assets, and services, restraining freedom of choice, preventing the development of capabilities, and eventually causing extreme poverty.*

Since the beginning of the introduction of geographers in marginalization research, which put more emphasis on the aspect of space (Déry et al., 2012), most of researchers analyzed economic and social aspects of marginalization.

In this research we analyzed concept of *marginality* as **multidimensional** concept following Gurung & Kollmair, (2005), Von Braun & Gatzweiler (2014); Mikuš et al., (2016), which in simplify way asks *where people are and what they have*. Therefore, marginality is observed through 4 groups of indicators ("sphere of life"):

- physical marginalization,
- demographic marginalization,

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- functional marginalization,
- economic marginalization.

Across Europe, marginalization has been highlighted as object of important political concern. However, in the area of Central Europe and the Balkans, the marginalization has not been sufficiently researched. Authors used different methodological patterns in the study of marginalization, most often treating demographic, socio-economic, cultural, ecological, political or physical-geographical dimensions (Nejašmić & Toskić, 2013; Šiljeg et al, 2016; Nejašmić & Toskić, 2016; Anđelković-Stoilković et al, 2018; Mrđen & Marić, 2018; Marić et al, 2020).

In BiH, there are a few authors who have dealt with marginal areas. Most authors considered the issue of spatial disparities in terms of depopulation (Nurković, 2006, Emirhafizović & Zolić, 2017; Gekić et al, 2020, Remenyi et al., 2022). Socio-demographic analysis of the border regions of BiH showed pronounced processes of marginalization and regional differences on the center-periphery line (Avdić et al., 2022), as well as a significant degree of heterogeneity of BiH's municipalities and cities. The limitation of creating more complex marginalization indicies can be attributed to the specific issues regarding statistical data in BiH. In addition to the limited availability of data for the level of local administrative units, a major challenge is long time intervals between censuses.

Measurement of marginalization can be done **qualitatively**, **quantitatively** (Déry et al., 2012; Abebaw & Admassie, 2014, Šiljeg et al., 2016; Mikuš et al., 2016) or combining approach. Since qualitative approach emphasize on the specificity and individuality of a research area, it is more popular in marginalization literature (Martínez-Martínez & Rodríguez-Brito, 2020). The quantitative approach is particularly valuable (Šiljeg et al., 2016). However, the GIS-MCDA has not yet been widely applied in different aspect of human geography.

Therefore, in this paper, the GIS-based multicriteria decision analysis (GIS-MCDA) was used in order to strengthen the methodological aspect of derivation of geographic marginalization model. The objectives of this research were:

- Propose a new methodological framework for quantification of geographical marginalization.
- Define groups of criteria that can be used in deriving a geographic marginalization model (G_{MAR}).
- Derive marginalization model for determined indicators.
- Derive the first geographical marginalization model (G_{MAR}) for BiH.

Materials and Methods

GIS-MCDA

The degree of marginalization is often quantified with a composite index (Luan et al., 2016). In this paper, for the derivation of the G_{MAR} 40 criteria was classified into 4 groups (Figure 1). After a literature, statistical and GIS data analysis, it was concluded that the selected set of criteria (Supporting Table 1) provides a faithful representation of marginalization.

GIS-MCDA analysis was performed using the GAMA extension (Domazetović et al 2019). The GIS-MCDA analysis consisted of six steps: (1) defining the objective; (2) determination of clusters and criteria; (3) standardization; (4) determination of weight coefficients; (5) aggregating the criteria.

The main objective of the GIS-MCDA (1) is derivation of geographical marginalization index (G_{MAR}) of Bosnia and Herzegovina using appropriate criteria which can potentially cause the occurrence marginality. The (2) selected criteria can be regarded as predisposing in their nature regarding the probability of marginalization occurrence. In order to achieve the best reliability of GIS-MCDA model these criteria were selected based on a detailed literature study in which marginalization was analyzed as a multidimensional concept. The selected criteria are different in terms of the unit of expression, which is why their (3) standardization, i. e. transformation to a unique scale (e. g. from 0 - 1 or 1 - 5) was carried out (Malczewski & Rinner, 2015).

Standardization was carried out in two steps: (a) fuzzy membership and (b) reclassification using the Jenks method. The fuzzy membership (FMS) method is common method within GIS that enables the standardization of criteria on a scale from 0 to 1 by applying one of the seven different membership types (MS). Choosing the appropriate MS is an extremely important step because it directly affects the standardization results. The fuzzy linear transformation function was selected. It applies a linear function between the user-specified minimum and maximum values. After the standardization of all criteria on a scale from 0 to 1, these values were reclassified using the Jenks method into 5 classes. This was conducted because the maximum values of all criteria do not necessarily indicate on marginalization occurrence. For example, a higher share of the old population, which has a value of 1 in the fuzzy classification, indicates a marginalized area, while higher value of the total population, which also has a value of 1 in the fuzzy classification, do not indicate marginalization.

Standardization is followed by the (4) determination of the weighting coefficients, which enables grading the in-

fluence of the selected criteria on the final model according to their perceived importance (Veronesi et al., 2017). One of the most popular methods for determining weight coefficients is the analytical hierarchy process (AHP) (Sałabun et al., 2016; Šiljeg et al., 2019), which is integrated within the GAMA tool. The determination of criteria was carried out on two levels:

a) derivation of an individual indicator of marginalization (e. g., physical, demographic, functional and economic);
b) derivation of the final G_{MAR} where each of the four indicators had a selected weighted coefficient.

For the first level, it was decided that due to the lack of literature, almost all criteria within one indicator have an equal impact on the derivation of the selected indicator. Exceptions were the total population and population density within the demographic indicator group. These criteria were collected at the level of settlement, which is a significantly more detailed level compared to the municipalities. Therefore, total population and population density had a higher weight coefficient (0.2) than other criteria (0.075) because they were collected at a detailed administrative level.

For the second level, it was decided that the weighting coefficients of the four indicators are equal (0.25).

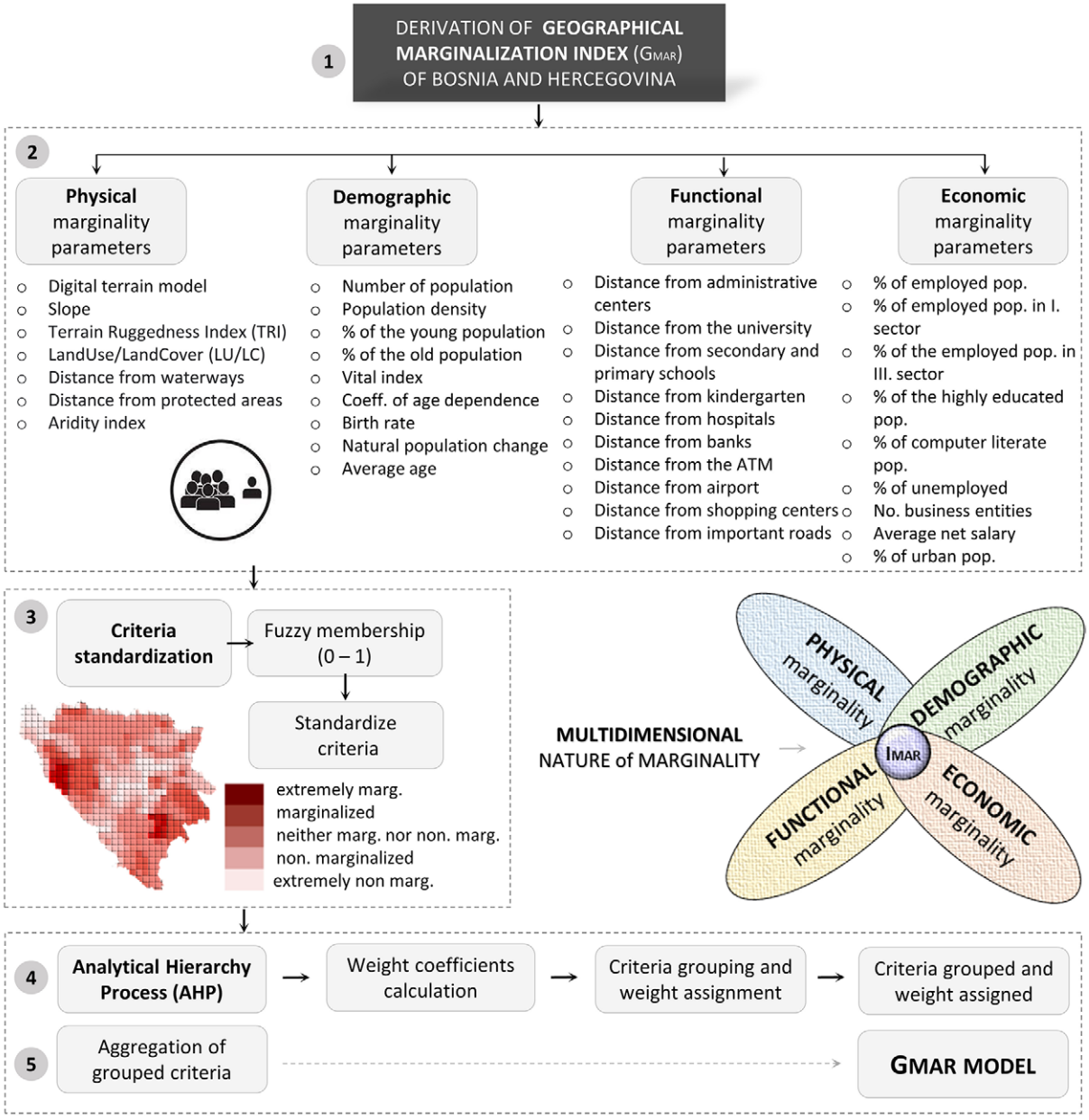

Figure 1. GIS-MCDA workflow in derivation of G_{MAR}
Source: modified according to Domazetović et al. (2019)

The last step of GIS-MCDA refers to the aggregation of indicators with the aim of deriving the final G_{MAR} model using the *susceptibility model aggregation* (SMA) tool.

Physical marginalization (P_{MAR})

In the derivation of the P_{MAR} 7 criteria were used (Supporting Table 1): elevation, slope, terrain ruggedness index (TRI); land use/land cover (LU/LC), distance from waterways and protected areas, and aridity index. All criteria had the same weight coefficient of 0.143. For the first three (a, b, and c) and the last criteria (f) the higher value indicates greater marginalization. In most cases, these areas are characterized by limited fertile soil, they have difficult access and harsh climates, making agriculture and infrastructure development challenging. The DTM downloaded from the DIVA GIS[1] (URL 1) was used. The model of slope and TRI was derived in ArcMap 10.8.1.

The LULC model for 2018 was acquired from the Copernicus[2] website. CLC uses a Minimum Mapping Unit (MMU) of 25 hectares (ha) (URL 2). The LU/LC model was reclassified into 5 classes. The reclassification was carried out in way that the thematic meaning of each class was observed regarding the possible effect on marginalization.

Classes such as: *Urban fabric; Industrial, commercial and transport units and Artificial, non-agricultural vegetated areas* received the lowest value of marginalization, while the classes: *Dump sites; Open spaces with little or no vegetation and Wetlands* received the highest marginalization values.

The distance from waterways and the protected areas can influence the marginalization of an area. Distance areas may face water scarcity, making it difficult for communities to engage in agriculture. Also, waterways can provide various economic opportunities. The waterways were acquired from the *Geofabrik*[3], and the distance model was created in ArcMap (URL 3).

Protected areas are characterized by rich biodiversity and can provide essential ecosystem services. Areas closer to waterways and protected areas often have better access to resources, economic opportunities which can reduce marginalization. Only National Parks and Nature Parks were included in the analysis (URL 4). The aridity index is a measure of the dryness or aridity of a region and is often used to assess the water availability and potential for agriculture. Aridity index model was downloaded from URL 5.

Demographic marginalization (D_{MAR})

In the deriving of D_{MAR} 10 criteria were used (Supporting Table 1). Vital statistics, age structure, total population, and population density were selected to detect demographically marginalized areas. Vital statistics data to the year 2022, and criteria like the birth rate, natural change, and the vital index were used. Higher values indicate more favorable demographic processes. Lower and even negative values (natural change), suggest a certain degree of natural depopulation, which can lead to spatial marginalization.

In the absence of census data, the values used for this group were based on estimates from relevant statistical institutions in BiH for the year 2022 (Federal Institute of Statistics and Institute of Statistics of Republika Srpska). It's important to note that the estimates at the level of one of the entities are based on the concept of a closed population. In this context, areas with higher values of the elderly population share, age dependency ratio, aging coefficient, and average age indicate a higher degree of marginalization compared to areas that experience more favorable conditions.

The estimated population for the year 2022, from which population density is derived, were used to observe the effects of current demographic trends.

Functional marginalization (F_{MAR})

In the derivation of the F_{MAR} 14 criteria were used (Supporting Table 1): real-time distance from capital city, from administrative centers, from universities (URL 6), from secondary schools (URL 7), from primary schools, from larger shops, from pharmacies, from hospital I. rank, from hospital II. rank, from hospital III. rank, from major roads, from airports, distance from banks. All criteria had the same weight coefficient (0.0714).

These criteria are presented with basic accessibility attribute – costs of traveling time (min). The areas with the greatest accessibility were regarded as non-marginalized, while the most remote regions are viewed as marginalized.

The road layer was acquired from *Geofabrik*. Hierarchically most important elements were selected. Attribute of maximum driving speed has been added. The topological check was done and travel cost calculated. A *Network Dataset* was created and real-time distance models derived using *Network Analyst*.

For the distance from administrative centers, the political-administrative structure of BiH has been taken into account. At the first level, the distance from all cantonal centers (Bihać, Orašje, Tuzla, Zenica, Travnik, Goražde, Mostar, Široki Brijeg, Sarajevo, Livno), mesoregional centers of Republika Srpska (Banja Luka, Doboj, Istočno Sarajevo, Bijeljina, Trebinje, and Prijedor), and the Brčko District has been calculated. Also, the distance from the capital city, Sarajevo, has been calculated.

[1] DIVA-GIS is a free computer program for mapping and geographic data analysis a geographic information system (GIS).
[2] Copernicus is an EU program aimed at developing European information services based on satellite Earth Observation (EO) and in situ data.
[3] Geofabrik is a company for-profit based in Karlsruhe offering OpenStreetMap consulting, training, tile servers, map styling and software development services.

To examine disparities, distances from primary, secondary, and tertiary formal education institutions were calculated. As BiH lacks an official register of public institutions, data from the 'Transparency International' database for the year 2021 were utilized. At the national level, the network of elementary schools comprises 536 public elementary schools, 278 secondary schools, and nine universities was used.

Degree of marginalization is also reflected in accessibility of healthcare infrastructure (Martinez-Martinez & Rodriguez-Brito, 2020). Data were obtained in the same way as for schools. The distance from healthcare centers is presented at three hierarchical levels, considering the organizational structure of the healthcare system (Džubur-Alić, 2018), which includes *clinical centers* (n=5), *hospitals* (n= 31) and *health centers and clinics* (n= 108). The distance from pharmacies, acquired from Geofabrik, was also used.

The greater distance from larger stores (shopping centers, supermarkets) implies greater marginalization and vice versa. The same applies to the banks. Both data were acquired from Geofarbik. For larger stores following attributes were extracted: *mall*, *convenience*, *supermarket* and *department store*.

Economic marginalization (E_{MAR})

In the deriving of the E_{MAR} 9 criteria were used (Supporting Table 1). All criteria had the same weight coefficient (0.111). The economic dimension is one of the most important in marginality (Blečić et al., 2023). The previous economic ranking of local government units in BiH was conducted using the Development Index. However, in this analysis it was not considered due to the incompatible calculation methodology. Most of the indicators chosen are based on the 2013 census. This is influenced by the asynchronous publishing of entity statistical offices, as well as the fact that certain indicators are not published at all for local government unit levels.

The selected criteria were: % of employed pop., % of employed pop. in I sector, % of employed pop. in III sector, % of highly educated pop, % of computer literacy, % of unemployed pop., % of urban population (2013 census), while the number of business entities and net wages represent the data from the 2021. An important methodological note concerns newly established local government units, for which data from the municipalities that they were part of until 2013 were used (e. g., Stanari - data from Doboj).

Results

Physical marginality model (P_{MAR})

Using stated physical-geographical criteria expected result have been generated regarding marginalization model (Figure 2). Areas characterized by steep slopes, high elevations, rugged terrain, and arid conditions are more marginalized (W central and SE part of BiH). These areas are characterized by limited agricultural potential, reduced accessibility, and challenges in infrastructure development. On the other hand, regions with gentle slopes, lower elevations, smoother terrain, exhibit lower marginality scores, indicating better suitability for various human activities and development.

Demographic marginality model (D_{MAR})

The marginalized areas in the D_{MAR} can be interpreted along the center-periphery line. The extremely marginalized regions are clearly observed at the western periphery of BiH (Western Bosnia), followed by the eastern areas along the state border (parts of Gornje Podrinje), and fragments of the far southern part of the national territory (Nurković, 2006; Avdić et al., 2022). The marginalization gradually decreases moving towards the interior (Figure 3), which points to what is known as an "extremely non-marginalized" state center. These results align with well-known patterns that are naturally predisposed. For instance, the interior valley-basin regions, such as the Sarajevo-Zenica basin, Tuzla basin, and even the Cazin region in the far NW, exhibit significantly more favorable demographic conditions compared to the BiH average. On the other hand, regions with higher degree of marginalization are generally economically weakened, post-war devastated areas with weaker physical predispositions for significant developmental.

Functional marginality model (F_{MAR})

Available database and used criteria point to the exceedingly significant importance of transportation infrastructure in revealing marginalization patterns in F_{MAR} (Figure 4).

Similar results were obtained as in the previous model, which indicates the scientifically proven connection between demographic, economic, and functional criteria (Meade et al., 1970; Prskawetz & Lindh, 2007).

It is evident that the highest concentration of various functions is centralized in the interior, around major urban centers such as Sarajevo, Tuzla, Mostar, and Banja Luka (Figure 4), which are relatively well connected both internally and intercity (highways and higher density of major roads). In F_{MAR}, the influence of these urban centers on the surrounding area is notable. Consequently, the degree of marginalization intensifies as one moves away from these centers and transportation hubs.

The most pronounced marginalization is in the far W and E border regions, which can be linked to intense and

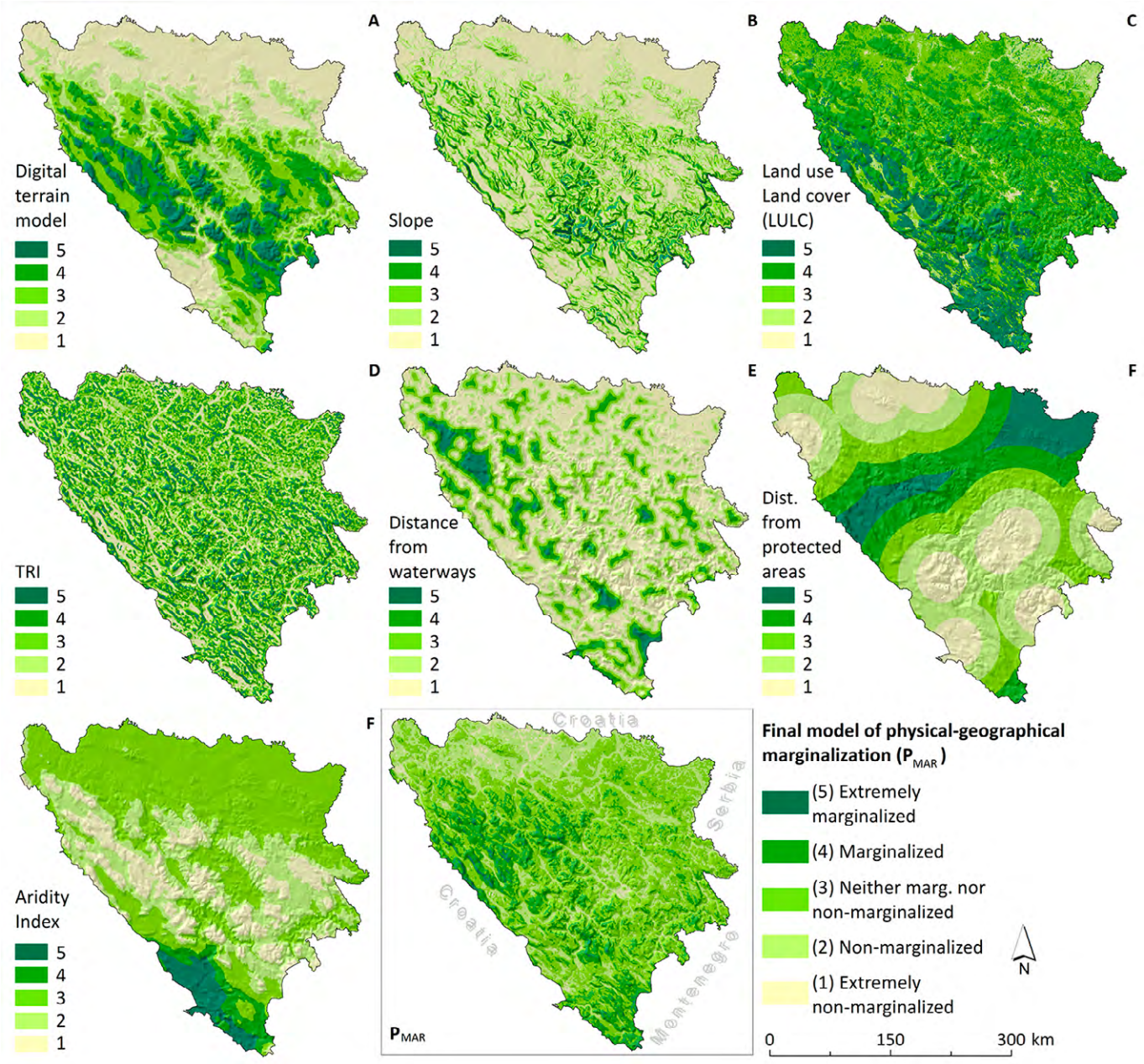

Figure 2. Physical marginalization (P_{MAR})

dynamic emigration processes (direct and indirect impacts of war), which disrupted the educational and healthcare function networks. In the F_{MAR}, it can be observed that a significant part of the national territory is marginalized to a certain degree, while extremely non-marginalized areas stand out only as smaller enclaves within the interior.

Economy marginality model (E_{MAR})

The E_{MAR} is derived from indicators that exhibit slightly different patterns of disparities compared to the other two models. Large urban centers are depicted as non-marginalized areas due to their high share of urban population, economic tertiarization, highly educated and digitally literate population.

Interestingly, a significant part of Herzegovina (urban centers) stands out as a non-marginalized region in economic terms. This is attributed to recent processes of economic revitalization, which are turning this historically significant region increasingly attractive for tourism, into an entrepreneurial area (Socio-economic Indicators by Municipalities of FBiH 2021).

Outside of significant urban regions (regional/cantonal centers), a large portion of the national territory is characterized by a higher degree of economic marginalization (Figure 5), where areas, particularly the northern Posavina

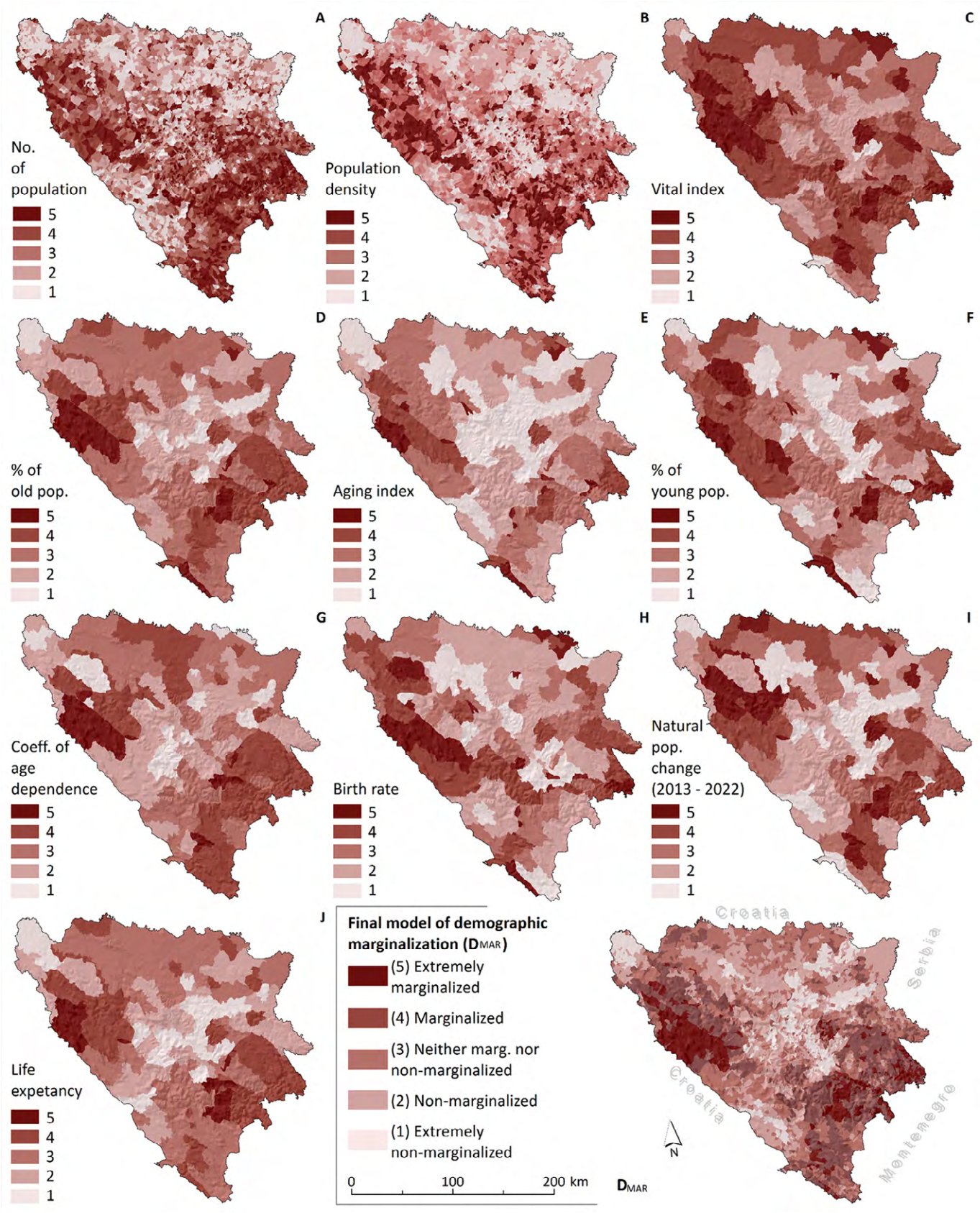

Figure 3. Demographic marginalization (D_{MAR})

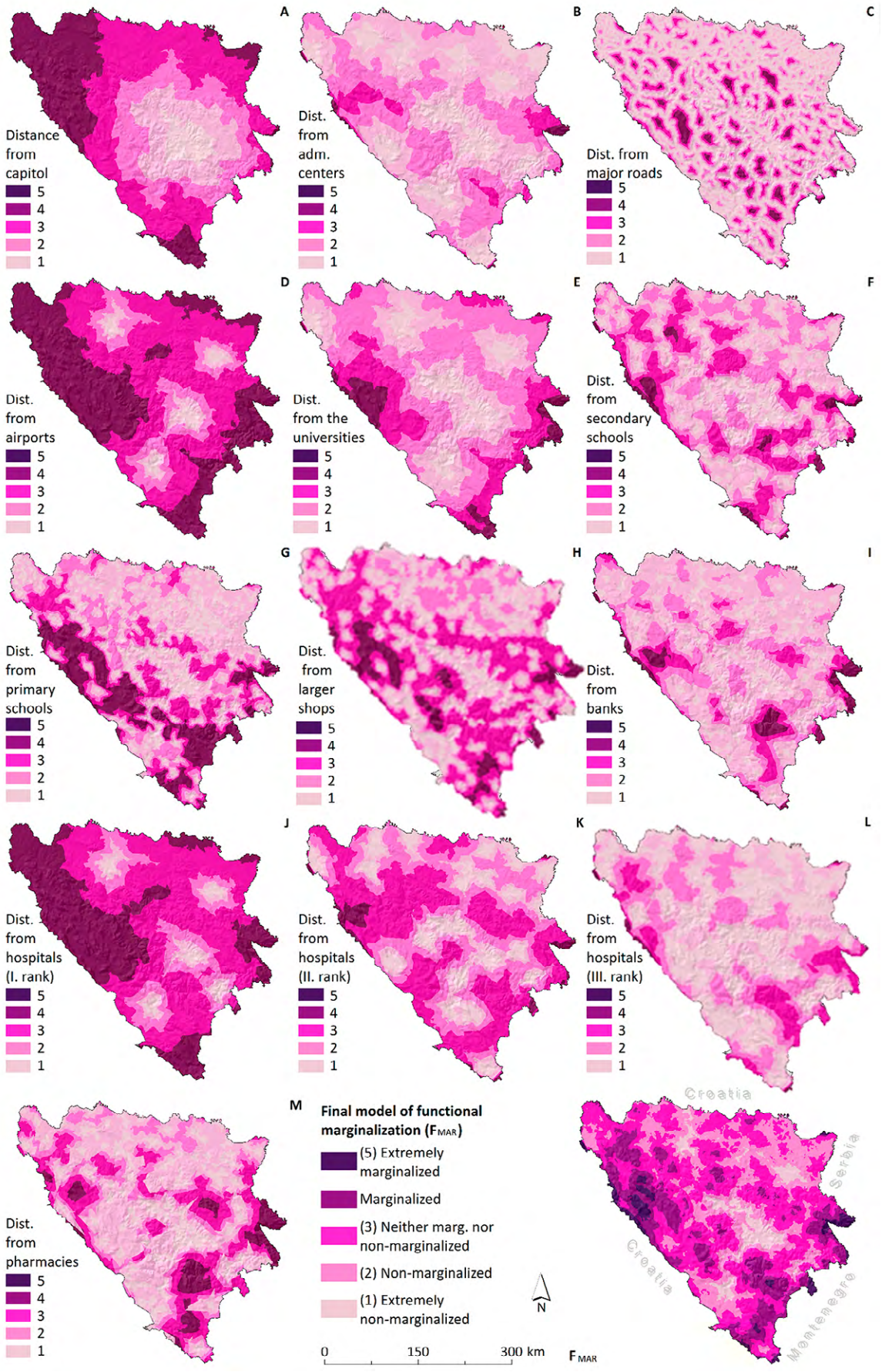

Figure 4. Functional marginalization (F_{MAR})

region, are economically homogeneous with a dominance of agricultural activities.

Extremely marginalized regions are detected in the far W and N border sector, as well as along the Inter-Entity Boundary Line. In future research, greater attention should be devoted to economic marginalization criteria, especially due to the methodological challenges in deriving socio-economic indicators.

Final Geographical Marginalization Model (G_{MAR})

In derivation of G_{MAR} marginalization models P_{MAR}, D_{MAR}, F_{MAR} and E_{MAR} were aggregated (Figure 6). All had the same weight coefficient (0.25).

In the context of BiH this is the first attempt at gaining insight in spatial differentiation of marginality at the sub-municipal level. The results point to regional disparities, as well as local variations within larger regional entities. The spatial distribution of marginality highlights two axes of BiH's overall social development, forming a morphology resembling the letter T (Figure 6). The first axis is naturally predisposed - it encompasses northern Bosnia, where several developmental hotspots of larger urban zones are located (Bihać, Banja Luka-Prijedor, Doboj-Tešanj, Tuzla, and Brčko-Bijeljina). The second perpendicular axis links the valleys of the Bosna and Neretva rivers, through which the Vc corridor is set to pass. This axis primarily includes two developmental focal points: the Sarajevo-Zenica area and the Herzegovina region (with a focus on Mostar). In contrast, large parts of east (Gornje Podrinje and Eastern Herzegovina) and western parts of the country can be considered extremely marginalized, both due to natural predispositions and historical passivity and the consequences of the recent war.

A relatively high degree of marginalization characterizes the hilly and mountainous areas in the central and even northern parts of the country. Interestingly, these maps indicate that the extremely marginalized areas are not located at a great distance from the centers of social development (e.g., Southeastern Bosnia in relation to Sarajevo, Eastern Herzegovina in relation to Mostar, or Western Bosnia in relation to Banja Luka). This could be interpreted as an opportunity for their improved prospects in the future. In this context, it is possible to determine that the administrative-territorial structure has a visible impact on the existing disparities, particularly evident in certain sectors (e.g., around Sarajevo, Mostar, Tuzla, Tešanj, Brčko, etc.), where sharp developmental-marginalization contrasts are noticeable within a small area.

The 5 most marginalized and the 5 most prosperous municipalities were derived. The five most marginalized includes:

- Bosansko Grahovo,
- Drvar,
- Istočni Drvar,
- Glamoč,
- Kupres RS.

Bosansko Grahovo is in local media recognized as "dying city" (URL 8). In it there is a few settlements so excluded and marginalized that it can only be reached from the neighboring country (URL 9). The municipalities of Drvar, Bosansko Grahovo and Glamoč are highlighted as extremely underdeveloped (URL 10 and 11). Namely after Dayton, Drvar was intersected by the Inter-Entity Boundary Line between Federation of BiH and Republika Srpska. In Drvar local residents mentioned distance from bigger settlements, poor traffic connections and lack of interest from Bihać as factors which catalize marginalization (URL 10). Kupres in the RS is also recognized as one of the most underdeveloped municipalities in BiH (Marković, 2021).

The five most prosperous (non-marginalized) includes:

- Novo Sarajevo,
- Novi Grad Sarajevo,
- Ilidža,
- Centar,
- Vogošća.

The most prosperous municipalities are administratively part of the Sarajevo Canton, three of which (Novo Sarajevo, Novi Grad, and Centar) are integral parts of the City of Sarajevo. Expectedly, these municipalities are the administrative centers, belonging to the first category according to the development index of the Federal Institute for Development Programming (Socio-economic Indicators by Municipalities of FBiH 2021). The most developed municipalities, as per the derived model, are regions with a high concentration of crucial administrative, judicial, healthcare, and educational functions, experiencing a more progressive economic growth rate compared to other regional units in BiH, as well as in relation to demographic development (Sarajevo Canton Development Strategy 2021-2027 – Strategic Platform). The comparative analysis of the ranking list of municipalities according to G_{MAR} with the development index confirms the relevance of the research procedure and points out the greater precision of the G_{MAR}, which takes into account a much larger number of criteria.

Bihać is a city located in the far NW part of the country that, following the derived model, has the greatest differences within its borders regarding marginalized/prosperous areas. Settlements near the city center are economically and demographically more prosperous compared to those situated along the administrative border towards highly marginalized municipalities like Bosanski Petrovac, Istočni Drvar, and Bosansko Grahovo (Bihać Municipality Development Strategy 2014-2023).

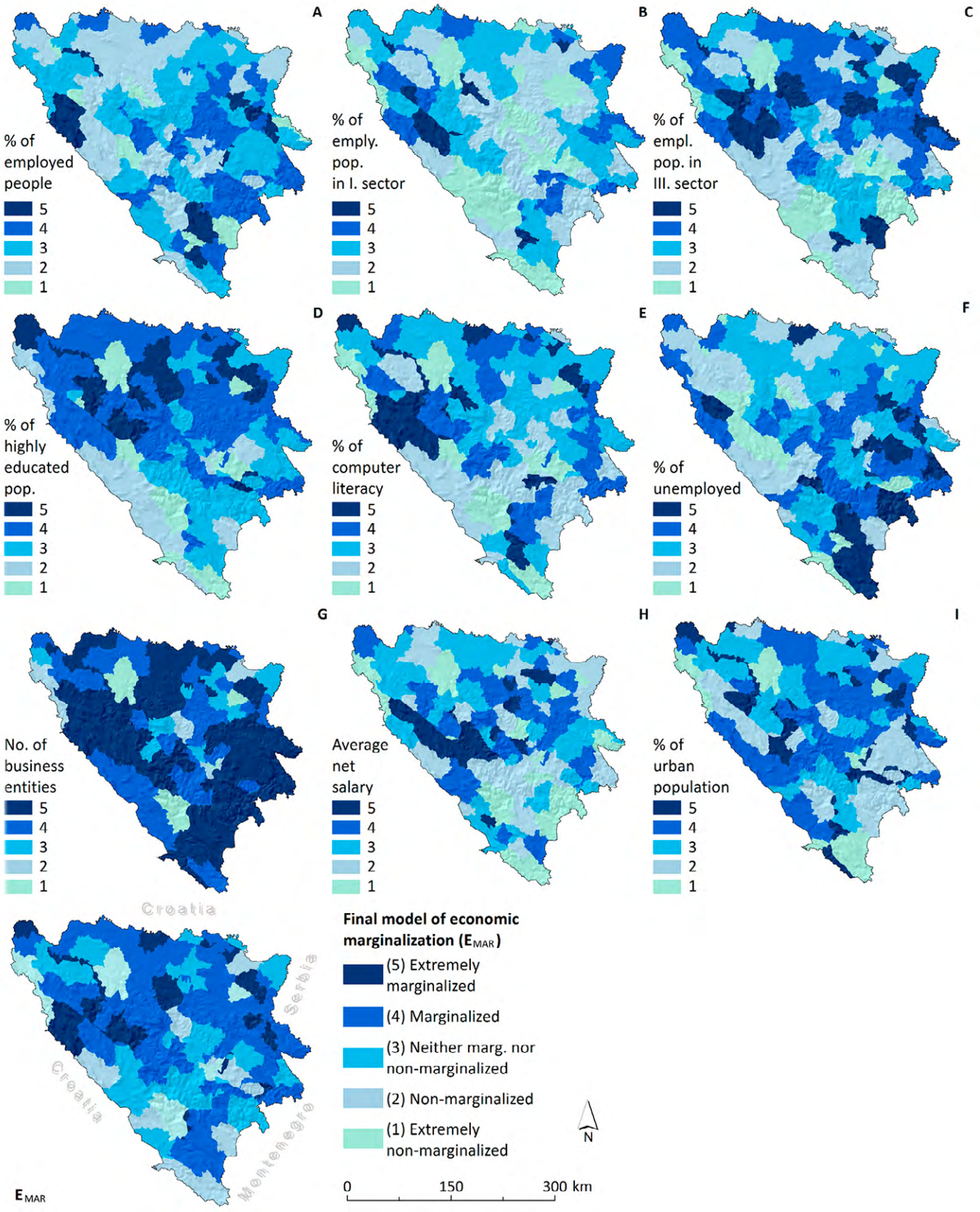

Figure 5. Economic marginalization (E_{MAR})

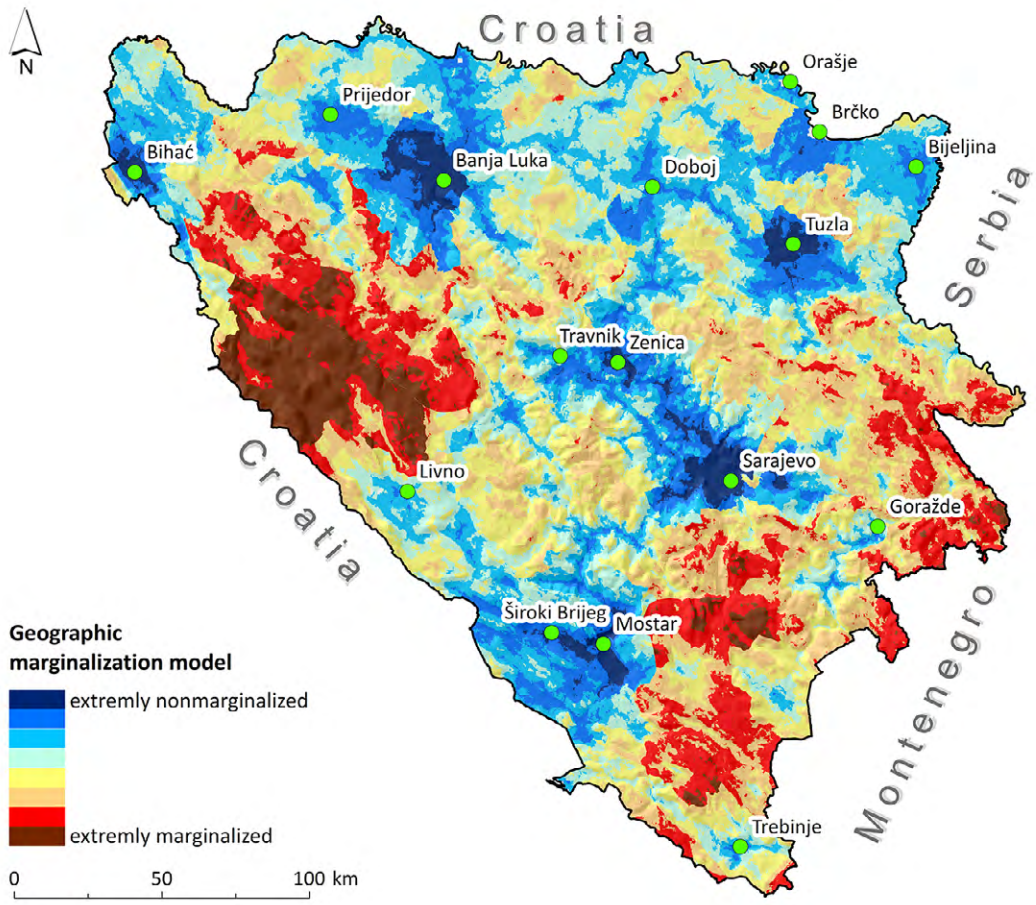

Figure 6. Final geographical marginalization model (G_{MAR})

Discussion

Methodology aspect

The methodology has proven successful in identifying highly marginalized areas. However, in the classification of non-marginalized zones, it shows a certain degree of generalization (e.g., Sarajevo and Bihać have the same degree of 'non-marginalization'), which could be nuanced in future research and adding more detailed criteria. It's important to note that the rigidity of municipal boundaries has led in some cases to abrupt transitions that do not reflect reality (e.g., the border of Banja Luka with Oštra Luka and Mrkonjić Grad). Such transitions occur due to administrative structure, where units that administratively belong to a larger and more developed urban center are depicted as significantly more developed than they should be.

A more precise picture and smoother transitions between municipalities could be achieved by examining economic, demographic, and functional criteria at the level of smaller spatial units – settlements units, which is a statistically limited procedure. Furthermore, attention should be paid to municipalities that are administratively divided along Inter-Entity Boundary Line (such as Kupres, Drvar, Trnovo, etc.) were data may devalue or overestimate the actual situation. Greater model granularity can be achieved by incorporating a broader set of criteria, such as those related to BiH's ethnic or cultural context, which, according to Grbić (1993), significantly impacts economic and political conditions in society. Degrees of social exclusion and social cohesion are desirable indicators that can further refine the processes of spatial marginalization (Dwivedi et al., 2007).

Validity of results

One of the main shortcomings of the G_{MAR} is the fact that quantification of marginalization is based solely on statistical data might not be entirely consistent or correct with the real situation. Underestimation or overestimation of marginalization can happen (Mikuš et al., 2016). Therefore, it is desirable to include the perceptual marginality of residents (qualitative methodology) in analysis. Furthermore, this data can be used in accuracy assessment of G_{MAR} through one of common validation methods (e.g.,

receiver operating characteristic, success and prediction rate curves, etc.). Considering the nature of marginalization as a complex condition that involves a certain level of vulnerability of social communities or groups due to unequal economic, political, cultural, and social factors, there arises a crucial need for analyzing the attitudes of the population originating from the detected marginal areas. A wide range of qualitative approaches exist, from autoethnographic studies to traditional qualitative methods such as surveys and interviews (Moore, 2018). Such insights can provide valuable inputs for a more detailed understanding of the causes and patterns of marginalization, serving as a valuable tool in formulating place-based policies aimed at demarginalization and the inclusion of problematic areas within regional development strategies.

Conclusion

Derivation of G_{MAR} is the first attempt at gaining insight into spatial differentiation of marginality at the sub-municipal level. The results indicate a deep disparity in BiH regarding marginalized and prosperous areas where two main axes of social development are observed – northern Bosnia with several larger urban zones (Bihać, Banja Luka-Prijedor, Doboj-Tešanj, Tuzla, and Brčko-Bijeljina) and a line connecting the valleys of the Bosna and Neretva rivers with two development zones: Sarajevo-Zenica and the region of Herzegovina with a focus on Mostar.

These zones can be considered, within the context of the mentioned methodology, extremely non-marginalized areas, while regions like Gornje Podrinje, Eastern Herzegovina, and Western Bosnia are extremely marginalized. Bosansko Grahovo stands out as the most extremely marginalized municipality, while Novo Sarajevo emerges as the most developed. Detecting marginalized municipalities can be a crucial step in uncovering patterns of marginalization in BiH, a country that is highly disconnected and lacks a strategic long-term plan for the de-marginalization of economically disadvantaged areas.

Limitations in the research primarily stem from a statistical nature and are tied to the availability and temporal consistency of data. However, a certain degree can be avoided in the future by incorporating a larger number of criteria at the settlement level. This could include factors such as ethnicity, poverty levels, and indicators of social cohesion and inclusion. The presented quantitative approach in future research can be complemented with a qualitative method. These could provide insights into the perspectives of the local population, allowing for a more nuanced understanding of the causes and patterns of marginalization. Such insights could serve as a valuable tool in shaping concrete place-based policies.

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Supporting Table 1. List of criteria used in derivation of G_{MAR} with sources and year of publication/data acquiring

Sphere of life	ID	Criteria	Source	Year
Physical marginality	1.1	Digital terrain model	DIVA GIS	2023
	1.2	Slope	DIVA GIS	2023
	1.3	Terrain ruggedness index	DIVA GIS	2023
	1.4	Land use/Land cover	Copernicus	2023
	1.5	Distance from protected areas	Wikipedia	2023
	1.6	Distance from waterways	Geofabric	2023
	1.7	Aridity index	Figshare	2023
Demographic marginality	2.1	Population number	statistika.ba, URL 11, Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	2.2	Population density	statistika.ba, URL 11, Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	2.3	% of young population	Socioekonomski pokazatelji po općinama FBiH 2022. Procjene stanovništvo 2013-2022. Procjene stanovništva RS 2013-2022	2022
	2.4	% of old population	Socioekonomski pokazatelji po općinama FBiH 2022. Procjene stanovništvo 2013-2022. Procjene stanovništva RS 2013-2022	2022
	2.5	Vital index	Statistički bilten 343, 360. Rođeni i umrli u Republici Srpskoj 130/23	2022
	2.6	Coeff. of age dependence	Statistički bilten 343, 360. Rođeni i umrli u Republici Srpskoj 130/23	2022
	2.7	Birth rate	Statistički bilten 343, 360. Rođeni i umrli u Republici Srpskoj 130/23	2022
	2.8	Natural population change	Statistički bilten 343, 360. Rođeni i umrli u Republici Srpskoj 130/23	2022
	2.9	Ageing index	Statistički bilten 343, 360. Rođeni i umrli u Republici Srpskoj 130/23	2022
	2.10	Average age	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
Functional marginality	3.1	Distance from administrative centres	Geofabric	2023
	3.2	Distance from capital	Geofabric	2023
	3.3	Distance from universities	Database of public institutions in Bosnia and Herzegovina	2021
	3.4	Distance from primary and secondary schools	Database of public institutions in Bosnia and Herzegovina	2021
	3.5	Distance from hospitals (I, II, III)	Database of public institutions in Bosnia and Herzegovina	2021
	3.6	Distance from banks	Geofabric	2023
	3.7	Distance from airports	Geofabric	2023
	3.8	Distance from larger shops	Geofabric	2023
	3.9	Distance from important roads	Geofabric	2023
	3.10	Distance from pharmacies	Geofabric	2023
Economic marginality	4.1	% employed population	Socioekonomski pokazatelji po općinama FBiH 2022.; Gradovi i opštine RS, 2022.	2022
	4.2	% employed population in I sector	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	4.3	% employed population in III sector	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	4.4	% highly educated population	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	4.5	% computer literate population	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013
	4.6	% of unemployed population	Zaposlenost, nezaposlenost, plaće i troškovi rada,2023; Plaće, zaposlenost i nezaposlenost RS, 2022.	2022
	4.7	Number of business entities	Socioekonomski pokazatelji po općinama FBiH 2022.; Gradovi i opštine RS, 2022.	2022
	4.8	Average net salary	Socioekonomski pokazatelji po općinama FBiH 2022.; Gradovi i opštine RS, 2022.	2022
	4.9	% urban population	Popis stanovništva, domaćinstava i stanova u Bosni i Herecgovini, 2013. Rezultati popisa.	2013

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The Identification of Cultural Tourism Geographies: Results from a Systematic Literature Review

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KEYWORDS

tourism
cultural heritage
local development
SLR

ABSTRACT

Tourism development allows the enhancement of the heritage of local cultural resources, expressing the territorial potential. The Systematic Literature Review shown in this paper highlight the relationship between "cultural heritage" and "tourism". The current state of the art and the specific relationships between the contents of the selected publications demonstrate that tourism is an indispensable tool in local communication and cultural promotion policies and strategies. The qualitative results allow the identification of cultural tourism geographies that coincide with four thematic clusters not evident in advance.

Introduction

Cultural heritage is a valuable resource for tourism that can encourage the definition of local development and promotion strategies. The interactions between heritage and tourism lead to the definition of tourism as an increasingly complex economic phenomenon with social and cultural implications. It being associated with the main tourist attractions and means of cultural exchange, cultural heritage has acquired special importance between public decision-makers and local communities (Boc et al., 2022). From a social point of view, the benefits of tourism related to this sector are linked to community pride, tolerance, and a stronger sense of identity (Cerquetti et al., 2022). Attachment to a place positively influences the behaviour of both tourists, in favour of sustainability and the environment, (Zhu & Chiou, 2022) both local residents, influencing their perception and support for tourism development. These effects represent a useful prerequisite to support local governments in the elaboration of more effective policies for the development and management of patrimony (Cao et al., 2021). The themes introduced are reflected especially in the minor contexts of rural areas, which are places of attraction for tourists looking for experiences, authenticity, slowness, and responsibility; the same attributes that were previously considered disadvantageous, are therefore now evaluated as opportunities (Brown & Hall, 2000). Indeed, cultural heritage and tourism are increasingly becoming factors of resilience in areas subject to demographic decline and depopulation (Gómez-Ullate et al., 2020). The challenge is to generate consensus among the inhabitants to develop projects that have a link with social and cultural heritage, also through the support of regional and local authorities (Signes-Pont et al., 2022). As stated by the World Tourism Organization, sustainable tourism aims to meet the needs of visitors, the environment, and the host communities, through the promotion of the optimal use of environmental resources, respect for local authenticity, support for the preservation of cultural heritage and traditional values, as well as ensuring long-term sustainable economic operations (UNEP & UWTO, 2005). In light of these premises, this article offers an overview of international scien-

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tific production with the aim of carrying out an analysis of the relationship between the two themes mentioned, namely "tourism" and "cultural heritage". This has been possible through the adoption of the methodology of the Systematic Literature Review related to the application of a Cluster Analysis technique. The study provides information from a quantitative point of view, evident in the definition of clusters useful to group the obtained data into macro-themes, that qualitatively, hesitate in the description of the contents of each cluster obtained. This activity is part of the research project admitted to funding under the "Municipal Doctorates" call of the Agency for Territorial Cohesion - Director General's Decree no. 288/2022, of which Professor Annunziata Palermo is the scientific director.

Methodology

The literature review is an essential feature of academic research. Indeed, the advancement of knowledge must be built based on existing work (Xiao & Watson, 2005). For this reason, the revision methodology developed in order to define the framework for the analysis of knowledge on the relationship between "tourism" and "cultural heritage" uses software support for the management of bibliographic data. The Systematic Literature Review (SLR) process is aimed at quantitatively systematizing the most current and relevant conceptual and applicative knowledge described in the literature on the subject. The consequential Cluster Analysis (CA) technique allows to interpret qualitatively the literature selected by the SLR process, in order to identify the main areas of research and then arrive at a structured definition of the "phenomenon" of interest (Chieffallo, 2021).

Specifically, the SLR makes it possible to identify existing studies, select and evaluate contributions, analyze and synthesize data, and report outcomes to allow clear results to be drawn (Chieffallo et al., 2023). As developed in Anwer & Aftab (2017), the SLR process includes the following steps:

1. Define the research question representing the research objectives. In the present case, the research question used is: "What are the main lines of research on the enhancement of cultural heritage for tourism?"
2. Find the keywords to form the query string. Starting from the research questions defined in the previous point, the search string used will be: "cultural heritage" AND "tourism".
3. Define the search space to get the data. In this study, reference is made only to the Scopus database, which, although the only source of research, is a sufficiently comprehensive starting point to identify the areas within which research activity should be located.
4. Set criteria to include or exclude documents. The documents used are all Open access and in English language.
5. Extracting literature. The data are extracted using the criteria defined in the previous step; in this case, the number of documents analysed is 960 articles.
6. Evaluate the quality of the studies carried out. For a useful and successful review, we consider the keywords indicated by the authors and the contents of the abstracts.
7. Summarise the required data. This phase involves the collection, organization and summary of the results through software "Bibliometrix" and "VOSviewer".
8. Document results and outcomes. In order to represent the results obtained, reference is made to some tabular and graphic products that document and summarise the relevant quantitative data.

The CA technique allows the grouping of heterogeneous units into several subsets, called clusters, which are as homogeneous and exhaustive as possible, allowing the achievement of a series of results (Fabbris, 1990) including typological research to identify groups of statistical units with distinct characteristics that highlight the physiognomy of the observed system, the definition of homogeneous classes (Green et al., 1967) and the generation of research hypotheses. CA is a purely empirical method of classification and as such is primarily an inductive technique. For analysis of this kind, the support of software for the management of bibliometric data is essential to process trend maps of research, that show the relationships between the keywords used in the selected documents and identifies clusters through the use of colours. In addition to this, the technique identifies the groups of keywords that most frequently coexist in publications through clustering models already implemented and validated.

Application and Quantitative Results

In this research work, the processing of the results has been possible through the use of two open-source software for the management of bibliometric data:

– *Bibliometrix*, a package for the statistical programming language R for quantitative research in scientometry and bibliometry (Aria & Cuccurullo, 2017).

– *VOSviewer*, software that can be used to generate, visualize and analyse bibliometric networks (Van Eck & Waltman, 2010).

The SLR process was developed with the support of Bibliometrix to perform a comprehensive analysis of the mapping of scientific literature. The software allows the import of bibliographic data, which in this case were obtained from Scopus database, using the query string. The import of the file on the software has allowed to derive the main data reported in Figure. 1.

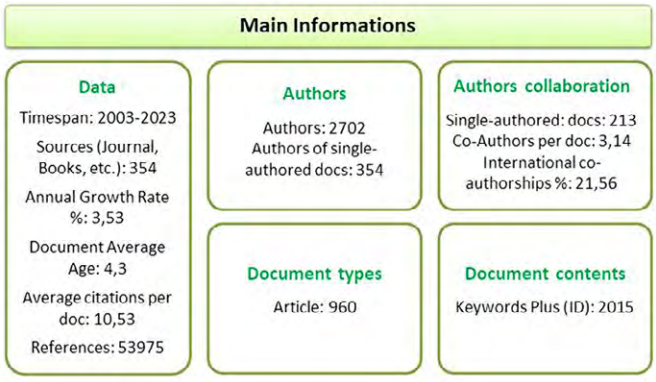

Figure 1. Description of main information and results

Through the numerous analyses that the tool allows to develop, it is observed that the production of scientific articles related to the combination "tourism" and "cultural heritage" has increased in recent years. As shown in Figure 2(a), in the period from 2003 to 2021, the discussion of this issue has seen a strong growth leading to an increase in the number of articles by more than 200%. Among the various sources, in particular, those that have proposed the most dissemination of the theme over time belong mainly to the European continent as the magazine *Sustainability* (Figure 2(b)).

An interesting aspect is the localization of the proposed contributions. The Three Fields Plot reported in Figure 3 shows through gradations of color the countries that have published on the theme, bringing out a production con-

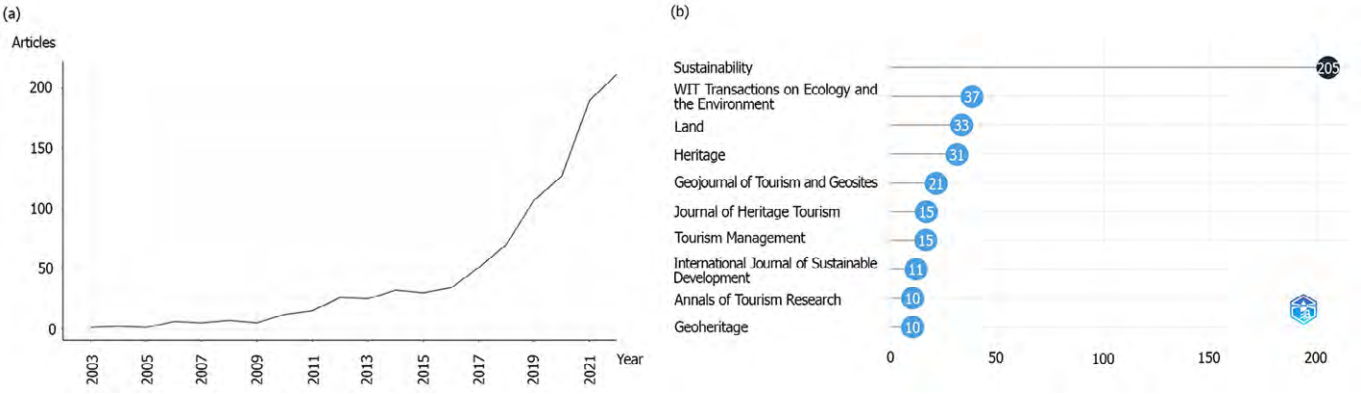

Figure 2. (a) Production Over Time; (b) Most Relevant Sources

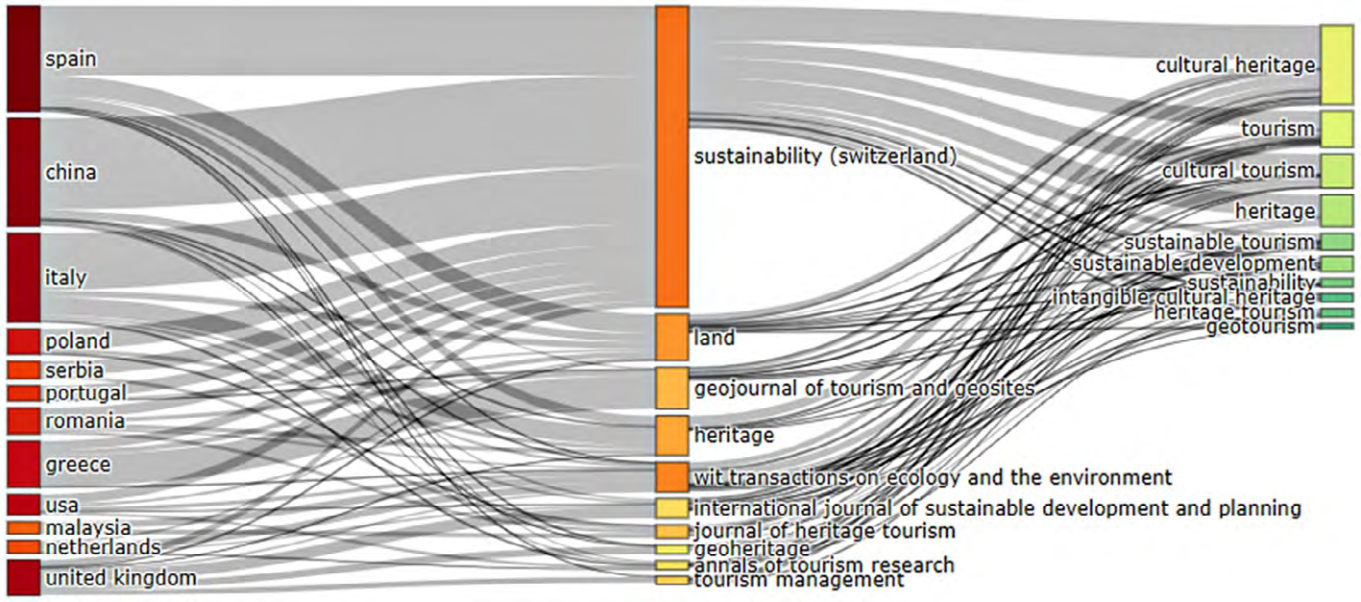

Figure 3. Three Fields Plot

centrated mainly in Europe and in some parts of Asia, first of all China. This type of representation allows you to visualize the main elements of three fields; in the case in question, the graph shows the connection between Countries (left), Sources (centre), and Keywords (right), confirming the analysis made with the previous elaborations.

A useful tool to intuitively view the specific issues addressed within the analysed documents is the so-called Word Cloud in Figure 4(a). It is a graphic representation of the most frequent words in a text, sorted by their visual impact. The Word Cloud is a great way to summarize information and immediately view key concepts through a particular use of text and graphics. In this case study, the keyword "cultural heritage" is dominant, followed by "heritage tourism" and "tourism development". The classification is also supported by the analysis of the frequency of words over time (Figure 4(b)); from the graph it is observed that the use of these keywords has grown in a clear way in recent years, demonstrating the trend of contributions to address these issues and confirming the primacy of the key concept "cultural heritage", followed by "heritage tourism" and "tourism development".

For the second phase of research, through the VOSviewer software, we proceeded with the application of the CA technique. Having identified the unit of analysis in the 4,997 keywords present in the selected literature, those were chosen that met the minimum threshold imposed of 20 occurrences, in number equal to 40. These keywords have been systematized in 4 clusters (Figure 5), associating a macro-thematic in each grouping:

To ensure immediate interpretation of the information provided by the software, maps have been created based on the data obtained. VOSviewer, in fact, allows you to link elements with networks created through co-authorship, co-oc-

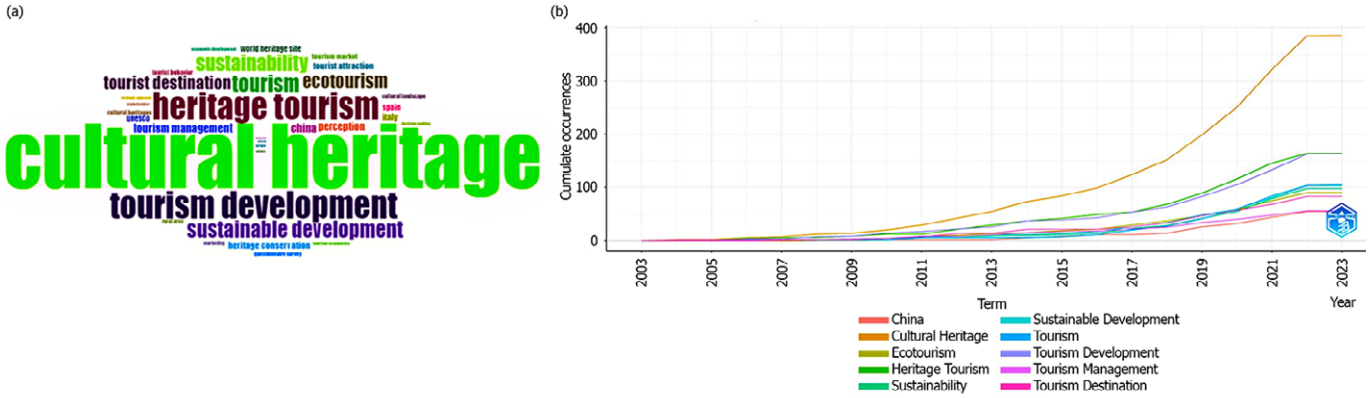

Figure 4. Word Cloud (a); Words' Frequency over Time (b)

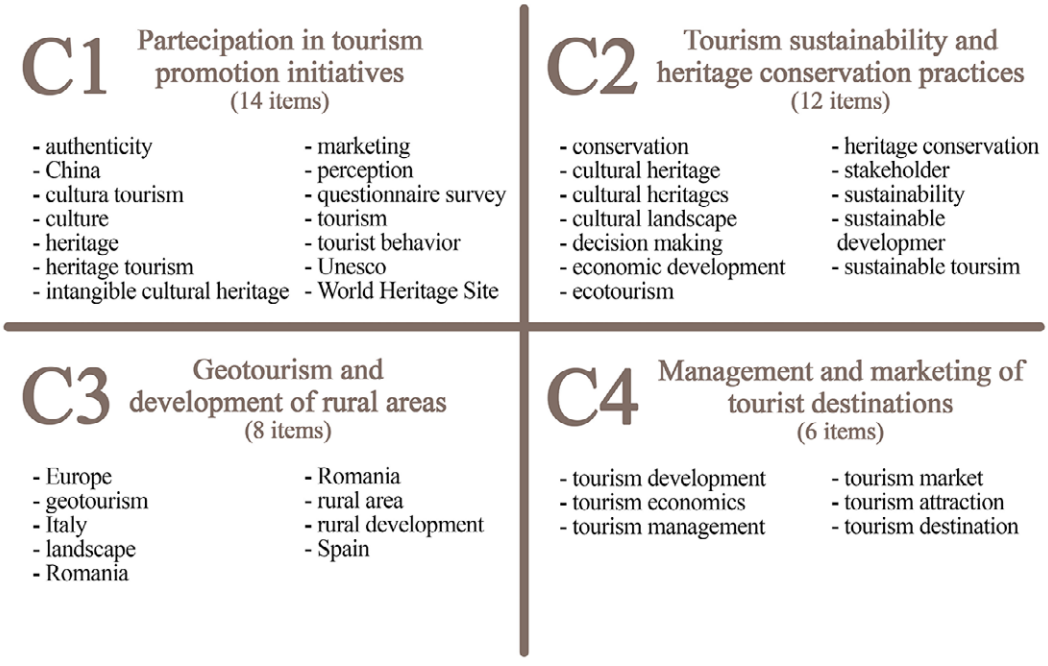

Figure 5. Clusters

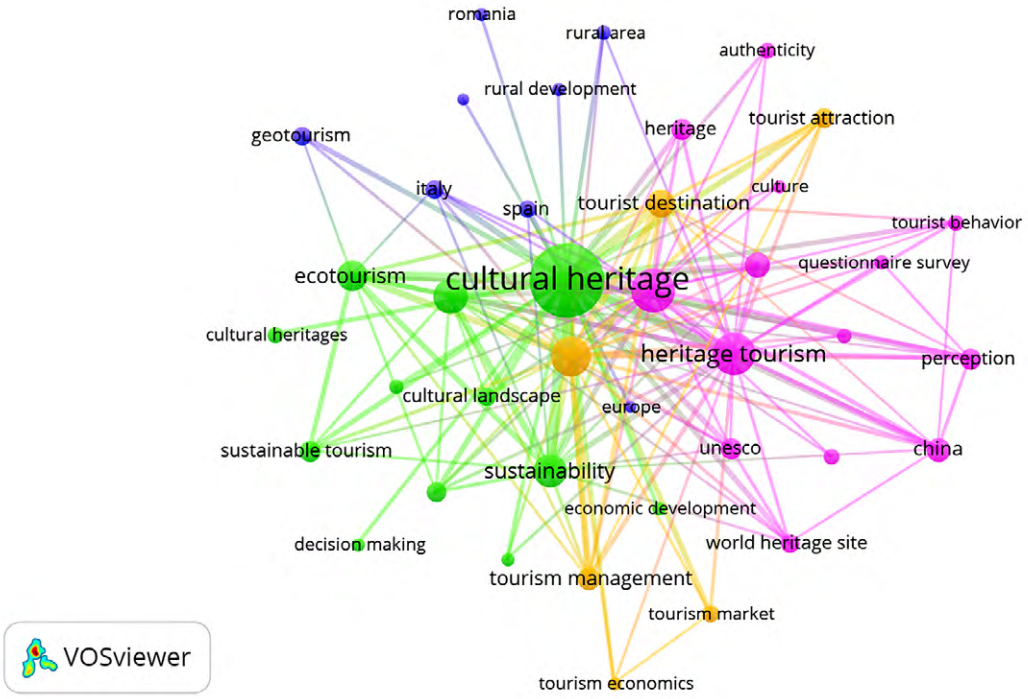

Figure 6. Network visualization

currence, citation, bibliographic coupling or co-citation links. In this work, the concept maps have been elaborated in order to summarize and outline the relationship between "tourism" and "cultural heritage". The first map, called *Network visualization* (Figure 6), is characterized by nodes representing the keywords linked together in order to define the mutual recurrence in small groups of publications. The size of a keyword and node is determined by the weight of the object, that is, it is proportional to its frequency of appearance in the analysed bibliographic database. The thickness of the connecting lines is proportional to the number of documents in which both keywords appear. By means of different colours are highlighted the 4 obtained clusters, are arranged in such a way as to bring back to the central part of the map the keywords that occur most frequently.

The map called *Density visualization* (Figure 7) aims to provide an overview of the main research areas investigated within the bibliometric network. Each keyword in the

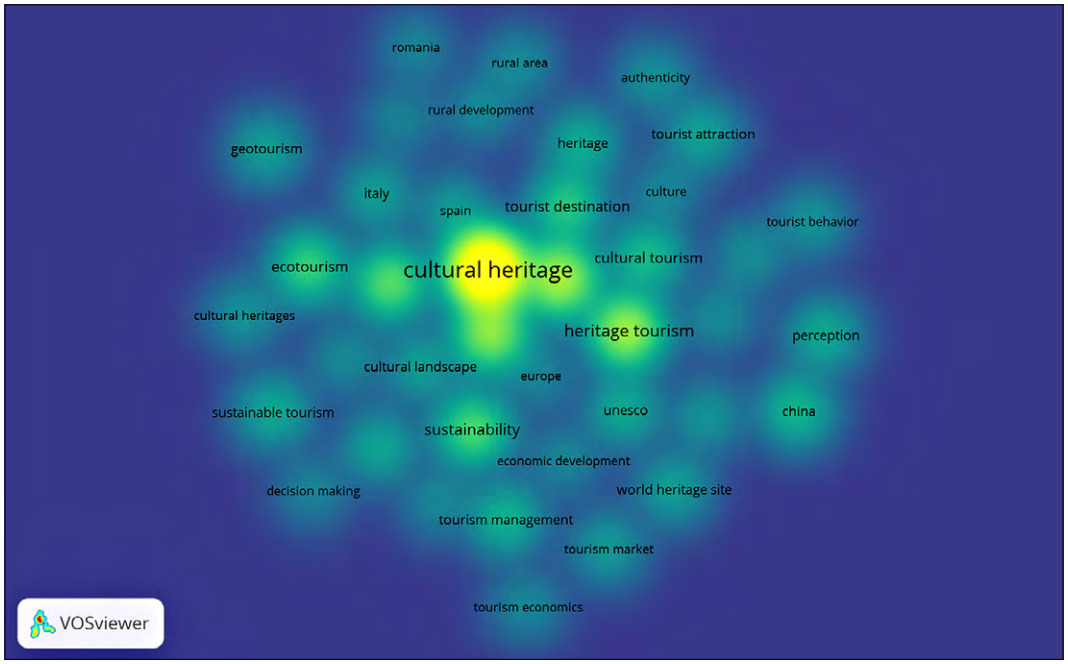

Figure 7. Density visualization

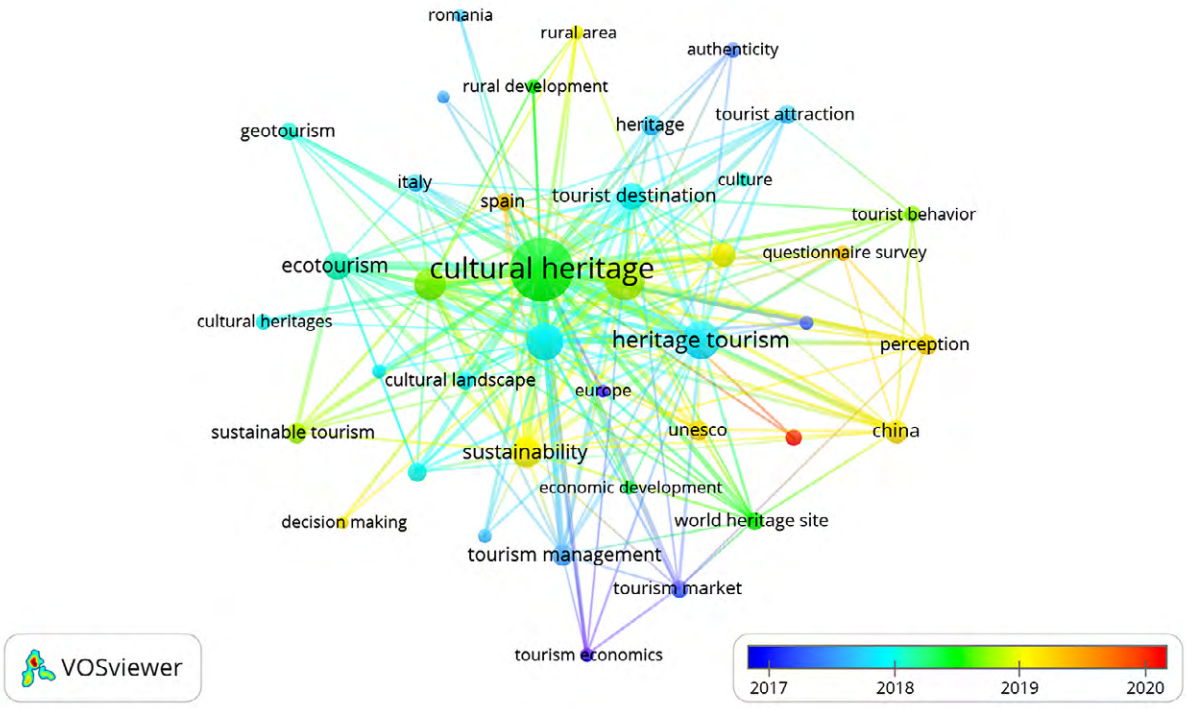

Figure 8. Overlay visualization

map has a colour that indicates the recurrence in the analysed contributions: the greater the use of that keyword, the more the colour of the point tends to yellow, conversely, tends to blue.

The software also allows you to extrapolate other maps useful for research purposes such as *Overlay visualization* (Figure 8), which allows you to view the developments of the search in a defined time frame.

Qualitative Results

Once the obtained clusters were identified and labelled, the authors considered it useful to accompany the quantitative results with a qualitative description of each one. Although the data obtained refer to the totality of the articles published in the period 2003-2023 on the Scopus database, the description process refers to a subgroup of the selected publications, that is those included in the period 2018-2023. This choice is justified by the desire to pay more attention to the most recent documents.

C1: Participation in tourism promotion initiatives

The tourism sector includes the enhancement of the existing heritage, with a focus on the components of the environment and cultural heritage that have a more marked value. As reported in Sarmento (2020), studying global tourism means thinking of it not only in terms of economy but also in terms of identity and differences in the representation of heritage, history, and the transformation of geographical spaces into significant places. Tourism is a global and complex phenomenon with a significant impact on space. Cultural tourism stands out among its many forms (Bitušíková, 2021; Kranioti et al., 2022; Krogmann et al., 2021; Zhang et al., 2020), which aims to explore different cultures and civilizations; it encompasses a wide range of tourist interests (Rech & Migliorati, 2021). Cultural resources appear to be an undervalued asset, as they can be used to develop the local tourism sector, especially in cities seeking new development paths (Kwiatek-Soltys & Bajgier-Kowalska, 2019). Since the 1990s, cultural tourism has been supported by the desire to satisfy a greater knowledge of the culture, history, and heritage of the chosen destination (Boulhila et al., 2022). Cultural tourism provides cultural itineraries for visitors (Kaiser & Woller, 2021) to explore the cultural heritage of the host region (Al-Jaberi & Hasan, 2022). Cultural heritage and its various elements are an important factor in supporting tourism development processes (Rapidah et al., 2018; Szubert, 2021) and cultural itineraries have the potential to revitalize and develop the historical area in a sustainable way, thus stimulating cultural tourism (Al-Jaberi & Hasan, 2022). The use of tools such as ArcGIS Server e WebGIS for the realization of interactive maps allows the promotion of guide

platforms for tourists that allow them to locate places and tourist services in a quick and easy way (Mohamed, 2021). The development of virtual reality and augmented reality model visualization technologies allows to experience cultural heritage sites (Briciu et al., 2020; Han et al., 2021; Kwanghee et al., 2020; Walmsley & Kersten, 2020). The development of innovative educational and tourist activities makes it possible to define rural revitalization strategies, promote community resilience in heritage sites, strengthen local values, and encourage social and economic efficiency (Shen et al., 2022). Among the various forms of heritage, intangible heritage has become an important area of tourism development for many countries hosting such resources (Eichler, 2021; Maags, 2021; Qiu et al., 2019). Indeed, it can activate the in-depth experience of tourists for local culture, to increase the attraction and competitive advantage of national or regional tourism (Wu et al., 2022). Tourists have become increasingly interested in intangible cultural heritage (Leonardi & Unterpertinger, 2022). Authenticity is important in this type of tourism (Tian et al., 2020) as it greatly enriches the experience (Lu et al., 2022) and has a positive effect on tourist satisfaction (Zhang, H. et al., 2018). As important forms of intangible cultural heritage, activities such as sports events are becoming a potential catalyst for tourism (Zhang, T. et al., 2018); also, festivals are a viable source of tourism promotion as they provide recognition to different cultures and communities (Antohin, 2019; Naqvi et al., 2018; Quand et al., 2022; Shi et al., 2019). One of the recurring promotion initiatives in literature is that of place branding which can be defined as the process of creating the identity of a place. Cultural heritage is a unique tool for place branding activities for territories (Fierro & Aranburu, 2019; Radosavljevic & Culafic, 2019). Often visitors document their experience on social media platforms, thus contributing to the branding process of the event and the place making process, involving lesser-known heritage values. Place branding, through urban festivals, focused on local built heritage, can also reduce the increasing pressure on urban centres in historic-tourist cities affected by overtourism phenomena (Kádár & Klaniczay, 2022). The use of social networks through trans media storytelling actions strengthens the value of destinations and increases their online reputation (Campillo-Alhama & Martinez-Sala, 2019). The use of these new forms of communication has favoured new ways of using cultural products (Fernández & Alarcón, 2020; Hugentobles, 2022; Longhi-Heredia & Marcotte, 2021). During the Covid-19 pandemic, the use of social networks enabled museum activities to maintain exchanges with the public, enrich the offer of services and strengthen the attractiveness of museums and cultural institutions (Palumbo, 2022). The use of software and technologies helps to define new promotional practices because they allow to build and provide agile experiences and increase the dissemination of cultural heritage (Gomez-Oliva et al., 2019).

C2: Tourism sustainability and heritage conservation practices

Sustainable management of cultural heritage tourism is becoming an important factor in the image of tourist destinations (Jurado-Rivas & Sánchez-Rivero, 2019; Kontiza et al., 2020; Weng et al., 2019). The concept of sustainability is growing and is becoming a dominant aspect in modern business (Palazzo et al., 2022). When it comes to sustainable tourism, three main criteria are laid down: economic, social and environmental criteria (Mayuzumi, 2022; Prevolšek et al., 2020). Sustainability is promoting economic growth that generates equitable wealth for all without harming the environment, becoming one of the objectives that serve as a starting point for many place branding strategies (Cristófol et al., 2021). It is necessary to ensure the sustainability of heritage sites and that the tourism they generate is revisited (Jelincic, 2021), containing current patterns of excessive tourism, such as mass tourism in historic centers (Bilotta et al., 2021), and the behavior of the tourists during visits which plays a central role in tourism activities (Cheng & Chen, 2022). Before the Covid-19 pandemic, mass tourism was the main driver of the unusual growth of tourist accommodation. The pandemic break can be seen as an opportunity to reset cultural heritage management policy and practice (Dastgerdi et al., 2021) because if not properly managed, it could lead to the destruction of the very resources on which it depends. Through the study of literature, different practices of tourist sustainability have emerged such as cycling tourism (Simeoni & De Crescenzo, 2018), ecotourism, the experiential tourism (Belliggiano, 2021) and slow tourism, a growing phenomenon especially in Italy where it is playing a key role in defining new sustainable tourism strategies for enhancing the landscape and cultural heritage, but also as an engine for the revitalization of the marginalized and internal areas of the country (Scandiffio, 2021). Among these, ecotourism stands out: it is based on the principles of protection of the natural environment and recognition of the original local culture in interaction with the environment (Üzümoğlu & Turkan, 2022). Ecotourism is increasingly accepted as a suitable alternative to supporting rural livelihoods (Kimengsi et al., 2019). This new form includes trips to destinations where flora, fauna and cultural heritage are the main attractions (Mekhum & Torasa, 2020). Cultural heritage is also seen as a tool for the development of sustainable tourism. It can be a driving force for economic growth in cities and regions (Kostopoulou et al., 2021). The natural conditions of the places, the level of conservation of the urban system and its development trends, constitute the value and identity of these cities and may serve as a basis for the development of

tourism, contribuing to its revitalization (Lakomy, 2021). As positives impacts, sustainable tourism generates jobs (Lukác et al., 2021), promotes local culture and products (Agustarini et al., 2022; Xiao et al., 2018), and tries to preserve as much as possible the links with tradition (Kutin & Telban, 2021). Its development implies responsible management of the areas (Krajnović et al., 2021) that can benefit traditional rural activities, the environment and heritage but, if transformed into overtourism, it can harm and damage the natural landscape (Iannucci et al., 2022). Visitors can boost an economy, but the rapid growth of tourism often has negative effects on both the built heritage and the lives of local inhabitants (Zubiaga et al., 2019). The main factors influencing heritage conservation include the lack of proper management, the lack of funds and the involvement of stakeholders (Mekonnen et al., 2022). The question of how to maintain and manage cultural landscapes whose economic benefits are not assured has become a priority in science and practice (Zscheischler et al., 2019). Cultural heritage sites, in addition to being a tangible link with the history and culture of a country, actively contribute to the national economy by providing a basis on which to develop cultural tourism (Kasnesin et al., 2019). One of the main risks to heritage conservation is manmade and is associated with the lack of cultural identification of local society with cultural heritage (Prados-Peña et al., 2019). The conservation of heritage sites is considered a vital component of their management as they are irreplaceable resources for the tourism industry (Basu, 2020). Sustainable public policies for cultural heritage management are needed (Magio et al., 2021). Proposing conservation strategies for the reuse and development of areas underlines the importance of a management plan aimed at preserving the historical character of areas and their sustainable development (Zitouni-Petrogianni et al., 2022). Italian cities represent a delicate context, where the concerns related to tourist flows and resource consumption are amplified by the concentration of sites and points of interest in urban areas, while tourism remains vital for economic growth (Lerario, 2022). In addition to the human factor, cultural heritage is threatened by climate change. Understanding exposure and vulnerability is challenging and rarely makes the risk and resilience assessment practice (Arrighi et al., 2022). There is a need to define decision support tools that focus on management priorities in order to exploit historic conservation and adaptation actions that improve the continuity of heritage values and sites (Li et al., 2021). The degradation of ecosystems can change the perceived value of destinations for tourists. For this reason, it is necessary to have accurate information on future climate change conditions that affect the attributes of the territory, not only to be more effective in the early prevention of threats to be prioritized but also to deal with potential damage to the tourism economy more efficiently (Lam-González, 2022). The preservation of cultural heritage must be supported by conservation guidelines, heritage site management plans and community involvement in order to achieve economic and social sustainability (Mekonnen et al., 2022).

C3: Geotourism and development of rural areas

In recent years, especially after the pandemic from Covid-19, a new trend in travel has increasingly emerged. Tourists are now oriented towards domestic rather than external offers, rural rather than urban regions (Oltean & Gabor, 2021). Rural tourism is one of the activities that can help to prevent depopulation by promoting the landscape and cultural heritage, also useful for their development and improvement, so that the abandonment of the territories is slowed or even reversed to the benefit of the local population (López-Sanz et al., 2021). The inclusion of elements of the natural landscape in tourism determines the birth of geotourism (Pereira et al., 2019) which represents a powerful and new form of eco-tourism compatible and sustainable that has rapidly expanded worldwide in recent decades, being crucial for the enhancement of geoheritage especially in rural areas (Filocamo et al., 2020). According to Scarlett & Riede (2019), geoheritage cannot be easily separated from cultural values and heritage; for this reason, it is necessary to merge the aspects of the latter with those of cultural heritage. To develop environmentally friendly tourism activities, it is necessary to build on the natural resources of cultural heritage and biodiversity (Sadowski & Wojcieszak, 2019), by including aspects of geodiversity within urban geoturistic pathways (Pereira & Farias, 2020). Designing a nature trail through the landscape for geotourism is a proposal for a new tourist product alternative to the traditional coastal tourist product "sun and beach" (Beltrán-Yanes et al., 2020). The paths have scientific/educational, cultural/heritage, landscape, and tourist, just like other geosites (Helgadóttir & Sigurðardóttir, 2018). Other elements that form the basis for the development of geotourism are geoparks (Skibinski et al., 2021). Tourism management is a great way to achieve sustainable development in rural areas and improve the quality of life of the resident population while respecting their natural and cultural heritage (Pérez-Calderón et al., 2022). Promoting geosite appreciation within a geotouristic framework can inspire a sense of nationalistic pride, thus creating an economic incentive for countries actively involved in geoheritage research and documentation (Rassios & Grieco, 2021). This sense of nationalistic pride can arouse in the original tourist of these sites a motivation that drives him to travel for the knowledge of the history of his territory as well as that of his family. For this reason, the theme of the so-called "Roots Tourism", although not present within the items of this cluster, emerges as a new trend, contributing not only to limiting the depopulation of rural areas but also to di-

versifying and seasonally adjusting the local tourist offer. According to Meini et al. (2018), the future challenges of geotourism concern the ability to recompose nature and culture in an interpretative unit, both theoretically and operationally, and the objective is to achieve an integrated tourist offer focused on the relationship between man and the environment in which the signs of territorialisation processes are expressed through economic vocations, traditional production chains, cultural values, and territorial identities. It is necessary that tourism planning and marketing maintain the integrity of the landscape avoiding the marginalization of local communities, so as to reduce cultural tensions between tourism and the landscape (Wang & Marafa, 2021).

C4: Management and marketing of tourist destinations

It is crucial to assess how tourists can be better understood and assisted through planning and marketing to attract more visitors (Sinha & Pratt, 2021). Marketing communication is vital for building a tourism brand (Li & Mahamood, 2022). To do this correctly it is essential to know first of all the opinions of the host communities on the impact of tourism (Gómez, 2019). Understanding the residents' points of view can help tourism managers and planners in order to minimize the potential negative impact and thus gain their support. It is also important to identify tourist landscape attractors so that they can make the most of their potential (Ridley, 2020; Zonouz et al., 2018). Useful activities for the purpose of retrieving feedback related to the tourist experience are conducting interviews or administering questionnaires to visitors to obtain opinions on management needs and development (Kaltenborn, 2019). The action of stakeholders is fundamental to implementing marketing initiatives also for those territories that although they have a significant natural and cultural heritage, are not necessarily tourist destinations. However, they can become so if supported by the active participation of local actors oriented to the development of the area (Beltramo, 2021). The involvement of stakeholders is one of the fundamental principles in the sustainable development of tourism (Rakitovac et al., 2021). Understanding the different approaches to development and the inclusion of the public in the process can significantly increase the sustainability of future tourism development (Sarenac et al., 2019). The participation of local communities allows them not only to be able to express their opinions but also to participate concretely in the processes of planning and managing heritage conservation (Beal et al., 2019).

Discussion

The systematic review of the literature has made it possible to show an overview of the main aspects related to the tourist enhancement of cultural heritage discussed on the international scene, allowing to observe the relationship between "tourism" and "cultural heritage" and its temporal evolution. The recent increase in the number of contributions published shows that this issue is attracting considerable and growing interest. In particular, the study made it possible to define a qualitative framework that could better define the themes and the contents of each cluster obtained. In the process of cataloguing the selected contributions, several articles were found to be linked to more than one cluster, including integrated information related to several themes. From a quantitative point of view, it has been observed that the international studies on the subject mainly concern Countries of Europe and Asia, thanks also to the variety that characterizes them in terms of cultural heritage, making them attractive and diversified destinations. The tourism sector has been affected by a transformation process due to several factors, first of all the development of the Covid-19 pandemic which has led to the definition of new needs of consumers in the sector and the emergence of new regional tourist markets. Nowadays, the concept of historical places and their importance emerges as they enjoy a heritage characterized by cultural and economic values, able to support the local economy through the adoption of a winning strategy of tourism marketing. Academic research also establishes the need and importance of community participation in decision-making, trying to understand the perspectives and motivations of people to participate in collaborative governance. Policy-making suffers from a lack of knowledge on how to effectively motivate and engage communities in heritage tourism management (Chauhan, 2022). Through the extrapolation of clusters, it has been possible to observe how aspects such as "sustainable tourism" or "cultural tourism", are emerging concepts in recent contributions. In this regard, the research found the absence of keywords related to the recent meaning called "Roots Tourism" which can contributes to diversifying and seasonally adjusting the local tourist offer. It is tourism generated by migrants who go on holiday to their country of origin, often after having been away for a long time, or by their descendants who want to visit and know the land of origin of their family (De Marchi & Mingotto, 2016). It is also known as tourism of the origins and return (Ferrari & Nicotera, 2021). The goal of this trend is to research one's own identity heritage, re-establishing a connection with the history of one's family. With this spirit, the Italian communities abroad can be involved in a strategy that has as its main objective to reverse the decline of the villages, actively supporting the revival not only of tourism but also of the culture and economy of our country. The new tourist phenomena in pe-

ripheral rural areas are destined to become important drivers of change because they can favour a "proactive conservation of the landscape" in substitution of the abandonment due to the coevolution between transformation, active citizenship, and tourism economy (Salvatore et al., 2018). The sustainable cultural tourism, placing cultural heritage and local communities at the centre of decision-making processes, offers the possibility of a new perspective that ensures that the results benefit both the heritage and the local population. From the results achieved, therefore, you can see how the way of tourism is changing, being more attentive to climate issues and the needs of users. If in the World Heritage Sites and the most important areas the problem of overtourism emerges, in the small rural areas, the problem is to search for forms of tourism that can attract more tourists, thus limiting the process of depopulation increasingly marked. Proposing the "Roots Tourism" is an innovative strategy that takes very interesting aspects to deepen in order to promote the image of rural areas. In addition to this, another aspect to be explored concerns the participation of communities. Although this theme is present in the selected literature, it is mainly addressed as a theoretical line and with little concrete evidence. Reference is made to future studies that may propose new forms of participation useful to encourage the local communities to choose strategies advantageous both to tourists and residents. The deepening of these two themes can also encourage the maturation of the sense of place. User involvement in local tourism development strategies can increase attachment to a place and positively influence the behaviour of tourists and residents.

Conclusion

The results obtained appear to be relevant for research into cultural tourism. However, some limitations of the adopted review process can be found in the criteria for inclusion/exclusion of contributions which are very limiting. In fact, widening the selected literature would allow to define more general clusters. Future research developments are expected to deepen the identified clusters, including through collaboration with other European universities. In particular, the choice was guided by the results of the cluster analysis that identify Italy, Spain and Romania as emerging countries. Therefore, for this purpose is being defined the formalization of an agreement between the authors' Department (Italy) and the Universidade de A Coruña (Spain) in order to deep the clusters emerged from the process of selection of the literature.

As regards the first cluster, cultural tourism is recognized as the main form of tourism, that allows to underline a relationship between tourism and cultural heritage currently promoted also thanks to the use of software that allow to realize interactive maps able to make easier and interesting the exploration of the heritage. Among the existing forms of heritage, the intangible type stands out, which constitutes a competitive advantage especially of national and regional tourism. Initiatives of place branding can favor the construction of the identity of a place, aspect that makes participates also the tourists through the use of the social networks. The development of innovative tourism activities therefore allows us to define revitalization strategies, especially in rural areas, thus promoting the resilience of communities.

The second cluster highlights the need to ensure the sustainability of heritage sites by containing the phenomenon of overtourism. In addition to the human factor, cultural heritage is threatened by natural disasters, invasive interventions and climate change. For this reason, it is necessary to have accurate information on future climate change conditions that affect the attributes of the territory at local level, not only to be more effective in the early prevention of threats to be prioritized, but also to deal with potential damage to the tourism economy more efficiently.

The third cluster, on the other hand, focuses on the practice of geotourism, which allows to include elements of the natural landscape in tourism, and the development of rural areas, highlighting the absence of forms of tourism that can motivate the original tourist of rural areas to know their own history.

The last cluster, finally, provide information on how to manage and promote tourist destinations, underlining the necessary active participation of local actors oriented to the development of the area.

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Re-evaluating the Place Attachment Concept and Developing the New Place Relatedness Scale: Evidences from Serbia

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ABSTRACT

The attachment can be directed towards the people (socially based attachment), but also can be based on the physical characteristics of the place or other factors. People in Serbia frequently change place of residence during educational stages or due to important family and life events. It also depends on other factors, such as ethnicity, tradition and environmental concerns. This study aims to re-evaluate the place attachment concept based on the well-established triple person-process-place concept and develop a new place attachment scale and apply. The survey included 1059 respondents. The SPSS was used for EFA relatedness calculations, Independent T-tests, and One-way ANOVA, while R and RStudio were used for CFA analysis. Four groups of factors were identified, leading to the development of a four-dimensional Place Relatedness Scale (4PRS): Family and Home, Social, Community and Everyday Life, Local Environment Bonding, Life Cycle. Certain differences were found between male and female respondents and in regard to other socio-demographic parameters.

Introduction

Currently, the population in developed countries is on the constant move (Gustafson, 2014). Despite all the travel options, there are a certain number of people who remain attached to their place of birth, natural surroundings, the geographical area recognizable and comfortable for them or on the other hand with the social surroundings and all the relevant factors that attract people to a place and contribute to them remaining there.

Place attachment expresses a set of feelings about a geographical location that emotionally binds a person to a specific place (yard, street, settlement, region) (Carmen Hidalgo & Hernández, 2001; Williams & Vaske, 2003). Such bonds inform us about our identity, they create a sense in our lives and facilitate community and impact activities. Place attachments also have a bearing on rootedness (Carmen Hidalgo & Hernández, 2001) and belonging to a certain geographical area (Diener & Hagen, 2020; Solarević et al., 2020). Some previous research has been based on observing neighborhood or community attachment and it is necessary to conduct more detailed research to define

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those factors that lead to this diversity and identify spatial and social factors that lead or could lead to local identity development (Hernández et al., 2007).

Some localities project a certain indefinable sense of well-being and become places we wish to return. Other environments, especially dramatic landscapes or locations of intense experiences, evoke an almost immediate, intimate and emotional association (Korpela et al., 2001; Manzo, 2005).The individualistic view assumes that attachment is formed to certain locations based on first-hand experiences. The socio-cultural perspective envisages that attachment and is formed through common cultural ideologies of groups and joint interactions with the place, which is important starting point for this research

A few researchers in Serbia have investigated place attachment mainly focused on the daily migrations and permanent migrations (Backović & Spasić, 2014; Petrović et al., 2017). Many people in Serbia change their place of residence after finishing secondary school and going to college, during employment, after marriage or following some important family decisions. A certain share of the population stay and plan to for the rest of their lives, those who have a family house or own apartment. To date there is a lack of research devoted to defining, measuring or assessing place attachment and applying it to several contexts among populationa in Serbia. The aim of this study is to introduce and develop a modified concept of place attachment, that is, time residing within in Serbia, based on the well-established triple concept of person-process-place (Scannell & Gifford, 2010) with respectively modifications.

This scale is designed to target a particular aspect or dimension of place attachment that is not covered by existing measures, such as Life cycle. It is identified that there is a need for a place attachment scale tailored to a unique context or population and cultural specificity. This context-specific approach is important for a more comprehensive understanding of the phenomenon.

Literature review

The attachment and meaning of a place reflect the connections between a person and the place that have developed through an emotional connection. Place attachment can also be explained as an individual's love for certain aspects of the place. Perceptions of place are constantly changing, depending on social interactions, context and time. Attachment to a place is a connection between a person and a place that develops from the specified conditions of the place and the characteristics of the people. The value of a particular place depends on its ability to meet the needs or goals of the behaviour of an individual or group compared to other place alternatives (Stedman, 2003).

In social science research, there are two general approaches that focus on how people react to the place where they live - quantitative and qualitative (Manzo, 2003). Quantitative research design uses numerical measures of response and may include objective measures (such as heart rate, test results) or self-assessment measures (such as scales describing emotions, visual preferences, and happiness). Qualitative research, on the other hand, is an effort to gain in-depth understanding and explore richer themes, patterns, and meanings of human and social situations.

According to Brown and colleagues (2004) three perspectives are relevant to a discussion of place attachment: biological perspective, the individualistic view and the socio-cultural perspective. Previous research reveals that people feel more comfortable in the type of landscape in which they grew up, can recreate and where they mostly feel at home (Adevi & Grahn, 2011). Older residents often become more attached to their neighbourhood because their sense of identity is tied to that place (Luo, et al., 2022). The attachments formed in childhood are often stronger than those formed later in life.

Organisms have a tendency to prefer environments that enhance their likelihood of survival and successful reproduction, as their environmental preferences are closely linked to the quality of the environment. Škorić and Kišjuhas (2020) pose a crucial inquiry regarding the extent to which human physical and mental well-being relies on interactions with natural systems and processes. This is particularly relevant due to the fact that humans have traditionally inhabited environments that have not undergone the same level of modification as contemporary environments. Although the social aspect of the world is often highlighted as the main environment in which humans developed, the significance of vegetation, landscapes, the natural world (including plants and animals), weather, scents, sounds, and other factors should not be undervalued.

Riger and Lavrakes (1981) determined two types of attachment employing factor analysis: one type is rootedness or physical attachment and the other is social attachment. Hay (1998) points out that the development of place attachment is regulated by factors such as rooting or heritage and length of stay. Some previous research has been based on observing neighborhood or community attachment (Brown et al., 2003), while others have observed city attachment (Bonnes et al., 1990). Perceptions of place are constantly changing, depending on social interactions, context and time. In cities, for example, changing patterns of social communication can create and undo places, rais-

ing or lowering the attractiveness of places (Cheng et al., 2003; Eisenhauer et al., 2000).

Most scholars present place attachment as a multiple concept that encompasses the connection between an individual and the environment (Altman & Low, 1992; Giuliani, 2003). One of the most well-known models is the three-part model proposed by Scanell and Gilford (2010) which views place attachment as a three-dimensional concept, with the following dimensions: person, psychological process and place. Feelings of connectedness or belonging that began in early childhood tend to become stronger in later years. The attachments formed in childhood, if a person lives in one place, are often stronger than those formed in new environments later in life (Morgan, 2009). Most research on place attachment focuses on the social aspect. Attachment can also rest on the physical characteristics of the place (Fornara et al., 2009). The definition of place dependence, for example, emphasizes the physical characteristics of places as central characteristics for the development of attachment because they provide benefits or resources to support one's objectives. A meaning-mediated model of place attachment (Stedman, 2003) suggests that people do not relate directly to the physical characteristics of a place, but to the meaning that those characteristics represent.

The study by Altman and Low (1992) elaborates on the connection between social activities and place attachment. Community ties are most often studied to predict attachment to a place (Bonaiuto et al., 2006; Brown et al., 2004; Casakin et al., 2021; Lewicka, 2005; Lewicka, 2010). Sense of security, in addition to community ties, has often been looked at as a predictor of place attachment (Brown et al., 2004; Kelly & Hosking, 2008; Lewicka, 2011).

Hernandez and associates (2007) made a difference between Place Attachment and Place Identity, developing the two-dimensional scale. Williams and colleagues (Williams et al., 1995) identified and evaluated 61 potential place attachment questionnaire items. Later, Williams and Vaske (2003) measured place attachment using 12 items taken from several previous studies that have shown good internal consistency. Raymond and colleagues (2010) measured place identity and place dependence with 11 scale items developed and validated by Williams and Vaske (Williams & Vaske, 2003).

Data and methods

The study covered all regions of Serbia's territory. The questionnaire consists of two parts. The first part measured sociodemographic characteristics (gender, age, place, education, socioeconomic status, ethnicity (Boley et al., 2021) with six additional household-related questions (number of household members, number of members younger than 18, number of members older than 18 (adults), total years spent in their settlement (residence length), total years spent in the same apartment/house, cohabitation with a married/unmarried partner in the same apartment/house). These additional questions have been selected based on a number of previous studies. According to Lewicka (2011), variables that have been included under socio-demographic predictors are residence length, age, social status, education etc., as used by Bonaiuto and colleagues (2006), Brown and colleagues (2004), Casakin and colleagues (2021), Hesari and colleagues (2019), Lewicka (2005), Shamai and Ilatov (2005) and others.

The second part contains 23 items measuring the place attachment, assessed on a five-point Likert scale. The items derived in this study are author's production based on the previous researches (Table 1).

The items were formulated based on the essence and themes found in the literature. They were developed by the qualitative and quantitative insights gained from previous research. The creation of these items was guided by the themes and characteristics observed in the literature, which enabled design of items that are particularly relevant to study's context. The questionnaire incorporates several novel items that have been intentionally developed to introduce new dimensions and perspectives of place attachment and to provide a more comprehensive understanding of place attachment, encompassing various dimensions and perspectives.

The data were collected face-to-face and via Google online forms from November 2021 to June 2022. During this process, 1059 questionnaires were completed. We used exploratory factor analysis to test the potential dimensions of the modified place attachment scale. Confirmatory factor analysis was used to test the measurement scale; place attachment dimensions construct in the proposed model were tested with the maximum likelihood method of structural equation modelling, which evaluates how well a proposed conceptual model with observed indicators and hypothetical constructs explains or fits the collected data (DeVellis, 2017; Raymond et al., 2010; Williams & Vaske, 2003). Observing the load of each item on the construction variables and using the fit index to test the model fit ensured the scale construction validity. The obtained data were processed by Statistical Package for Social Sciences Version 23 – SPSS, which was used for EFA calculus, and for the CFA analysis authors applied R and RStudio (lavaan, semPlot, psych,semTools, GPArotation and MBESS packages). For final analysis Independent T-test and One-way ANOVA authors again used the Statistical Package for Social Sciences Version 23 – SPSS.

Table 1. List of items used in questionnaire

Items	Supporting literature
Most of my family lives here	Casakin et al., 2021; Kyle et al., 2005; Raymond et al., 2010; Scannell & Gifford, 2010
My parents/children/grandchildren live here	Kyle et al., 2005
My relatives live here	Bonaiuto et al., 2006; Kyle et al., 2005; Lewicka, 2005
My home is here	Raymond et al., 2010; Williams & Vaske, 2003;
My work is here	Bonaiuto et al., 2006; Lewicka, 2005
I know almost everyone here	Kyle et al., 2005; Raymond et al., 2010; Scannell & Gifford, 2010; Williams & Vaske, 2003
Almost everyone knows me here	Kyle et al., 2005; Raymond et al., 2010; Williams & Vaske, 2003
I like the local environment	Casakin et al., 2021; Scannell & Gifford, 2010; Schultz, 2001
I feel very comfortable here	Hesari et al., 2019; Kyle et al., 2005; Schultz, 2001; Williams & Vaske, 2003
I like the church in my place	Bonaiuto et al., 2006; Casakin et al., 2021; Lewicka, 2005; Scannell & Gifford, 2010
I went/go to school here	Kyle et al., 2005; Scannell & Gifford, 2010
I grew up here	DeVellis, 2017; Williams & Vaske, 2003;
The places where I buy are suitable for me	Introduced by authors
I raised/am raising a family there	Kyle et al., 2005
I want to die and be buried here	Introduced by authors
I got married or plan to get married here	Introduced by authors
I feel safe here	Brown et al., 2004; Raymond et al., 2010
People take care of me and I take care of them	Kyle et al., 2005; Raymond et al., 2010
Family legacy is very important to me	Kelly & Hosking, 2008; Kyle et al., 2005; Raymond et al., 2010;
My doctor is here	Introduced by authors
I have favorite places to walk and relax here	Schultz, 2001
I love all the seasons in my place	Schultz, 2001
My family has a property here or nearby	Kelly & Hosking, 2008; Kyle et al., 2005; Williams & Vaske, 2003

Source: Authors' reproduction

Results

In the sample of 1059 respondents, there is a higher number of females in the sample (58.6%) with the majority of all respondents in the 21-30 age category. About the half of the respondents are employed (47.4%) with secondary school degree (54.6%). These results are presented in Table 2. The majority of respondents live in urban settlements, 75.4%. About the two-thirds of respondents declare themselves as Serbian with one-third of respondents stating undeclared.

Table 2. Sociodemographic characteristics of respondents (N=1059)

Gender		Education		Place of residence	
Male	41.4%	(Un)completed Elementary school	2.8%	Urban	75.4%
Female	58.6%	Secondary school	54.6%	Rural	24.6%
Age		BSc degree	32.7%	**Ethnicity**	
under 20	13.0%	Master degree	7.6%	Serbian	61.1%
21-30	41.7%	PhD degree	2.3%	Hungarian	1.2%
31-40	14.1%	**Socio-economic status**		Bosniak	1.6%
41-50	16.2%	Pupil/Student	39.1%	Croatian	1.0%
51-64	10.6%	Employed	47.4%	Goranac	1.8%
65+	4.3%	Unemployed	8.2%	Undeclared	32.2%
		Retired	5.3%	Other	1.0%

Source: Authors' reproduction

Exploratory factor analysis: four-dimensional place relatedness scale (4PRS)

Exploratory factorial analysis (EFA) was performed on the data set of 1059 respondents measuring latent variable on place attachment. The results of EFA (principal component analysis) with Varimax rotation: factor loadings are presented in Table 3. A Kaiser-Meyer-Olkin measure yielded 0.923, and Bartlett's test of sphericity was 12838.705 (df = 253, p<0.000), showing high significance, so further factor analysis was appropriate. Four factors were extracted explaining at least 59.284% of the total variance. Reliability coefficients (Cronbach's α) of all relevant variables in the rotated factor matrix ranged from 0.769 to 0.858 (Table 3), which is above 0.7 threshold. According to the factor loading scores for each item, four components are interpreted as four different place attachment dimensions, which are (Family and Home – FH, Social, Community and Everyday Life – SCEL, Local Environment Bonding – LEB, Life Cycle - LC). Observing that only the third dimension aligns closely with the conventional definition of place attachment, this study reinforces the idea of developing new scale, respectively named four-dimensional place relatedness scale (4PRS). Developed scale extends beyond traditional place attachment and delves into related constructs that influence individuals' connections with their place of residency.

Table 3. Descriptive statistics for each latent variable and its items

DIMENSIONS AND ITEMS	Mean	Factor loadings	Eigen value	Cronbach's α	McDonald's Omega - ω	Variance explained (%)
Family and Home - FH	3.569		9.012	0.858	0.89	19.024
FH1 Most of my family lives here	3.78	.846				
FH2 My parents/children/grandchildren live here	3.91	.838				
FH3 My relatives live here	2.98	.592				
FH3 My home is here	4.20	.705				
FH4 I grew up here	3.46	.688				
FH5 Family legacy is very important to me	3.39	.383				
FH6 My family has a property here or nearby	3.42	.520				
Social, Community and Everyday Life - SCEL	3.129		2.232	0.825	0.9	15.969
SCEL1 I know almost everyone here	3.24	.528				
SCEL2 Almost everyone knows me here	3.02	.555				
SCEL3 I like the church in my place	3.25	.603				
SCEL4 I went/go to school here	3.47	.584				
SCEL5 The places where I buy are suitable for me	3.22	.562				
SCEL6 My doctor is here	3.05	.646				
Local Environment Bonding - LEB	3.867		1.245	0.839	0.89	14.916
LEB1 I like the local environment	3.64	.777				
LEB2 I feel very comfortable here	3.97	.818				
LEB3 I feel safe here	4.01	.671				
LEB4 People take care of me and I take care of them	3.86	.385				
LEB5 I have favorite places to walk and relax here	3.70	.602				
LEB6 I love all the seasons in my place	3.64	.570				
Life Cycle - LC	3.189		1.146	0.769	0.82	9.375
LC1 I raised/am raising a family there	3.26	.662.				
LC2 My work is here	3.47	712				
LC3 I got married or plan to get married here	3.29	.565				
LC4 I want to die and be buried here	4.01	.381				
Overall Scale Reliability				0.95	0.94	

Source: Authors' reproduction

Measurement model validity for the four-dimensional place relatedness scale (4PRS) – Confirmatory factorial analysis

The latent factors measurement model was estimated to check for innate construct validity and reliability using Confirmatory factorial analysis CFA. Initial model fit indices were showing moderate results and moderate fit indices, which were below or above threshold (CFI = 0.892 (>0.95), TLI = 0.878 (>0.95), RMSEA = 0.118 (<0.08), SRMR = 0.083 (<0.08), df = 253, p<0.000), thus revealing potential problems associated with the model. Therefore, the modification indices needed to be used. Several items with high residual were excluded: Family and Home – FH (FH2+FH5), Social, Community and Everyday Life - SCEL (SCEL3+SCEL4+SCEL5+SCEL6), Local Environment Bonding - LEB (LEB1+LEB5), Life Cycle - LC (LC2+LC3), thus defining model with a satisfactory fit (CFI = 0.980, TLI = 0.973, RMSEA = 0.081, SRMR = 0.046, df = 78, p<0.000). Final scale for place attachment factors included four latent factors with 13 relatedness items in total.

Scale reliability was assessed through through the Cronbach's Alpha (α), McDonald's Omega (ω), Composite Reliability (CR) and Average Variance Extracted (AVE) indices, as outlined in Table 3. Values of Cronbach's Alpha (α) and McDonald's Omega (ω) are above 0.7 threshold (Hayes, & Coutts, 2020), thus proving scale reliability. The convergent validity of each dimension was examined by calculating the score of the average variance extracted (AVE) (Fornell and Larcker, 1981). A substantial convergent validity is achieved when all item-to-factor loadings are significant and the AVE score is higher than 0.50 and (CR) is higher than 0.60 within each dimension (Fornell & Larcker, 1981). The results showed that all dimensions had AVE higher than 0.50 and CR higher than 0.60, which indicates good convergent validity: for Family and Home AVE = 0.59, CR = 0.88; for Social, Community and Everyday Life AVE = 0.89, CR = 0.94, for Local Environment Bonding AVE = 0.53, CR = 0,82, for Life Cycle AVE =0,64, CR = 0,78.

Discriminant validity was then checked by comparing the square root of each average variances extracted (AVEs) with the correlation coefficients for each latent construct. Fornell and Larcker (1981) noted that the discriminant validity is guaranteed when the square root of each AVE is greater than the correlation coefficients estimate.

The square roots of AVE values were all higher than the correlation values of constructs compared to all other constructs; the results confirm that all dimensions have sufficient discriminant validity (Fornell & Larcker, 1981; Zait & Bertea, 2011), which is shown in Table 4. Regarding HTMT, discriminant validity violation is met if the HTMT ratio is close to one (Henseler et al., 2015). Some authors suggest a cut of value of 0.85 (Clark & Watson 1995; Kline 2011), whereas others propose a cut of value of 0.90 (Gold et al., 2001; Teo et al., 2008). Table 4 shows that all values are below 0.85 (values mentioned in italics in brackets), indicating that there were no violations of HTMT0.85. Overall, the results for the measurement model indicate scale reliability and validity.

Table 4. Discriminant validity 4PRS (Fornell-Larcker criterion and HTMT)

	FH	SCEL	LEB	LC
FH	0.77			
SCEL	0.551(*0.709*)	0.94		
LEB	0.428 (*0.682*)	0.465 (*0.607*)	0.73	
LC	0.46 (*0.771*)	0.494 (*0.682*)	0.459 (*0.780*)	0.8

** Family and Home – FH, Social, Community and Everyday Life – SCEL, Local Environment Bonding – LEB, Life Cycle - LC*

Source: Authors' reproduction

Descriptive statistics on socio-demographic implications on place attachment dimensions

The relatedness of the scale was tested regarding the respondents' gender, age, education, socio-economic status, ethnicity, place of residence, households and duration of living in the current place of residence and current apartment or house in relation to 4PAS scale. Independent T-test showed that males gave a higher value to SCEL factor (t=2.636, p=0.009). According to the place of residence, rural respondents gave higher value to FH factor (t=5.011, p=0.000) and SCEL factor (t=3.671, p=0.000) than urban respondents.

Further differences were identified using One-way ANOVA and Post Hoc LSD Test in regard to age, education, socio-economic status, ethnicity, number of household members and duration of living in the current place of residence and current apartment or house. No statistical significance differences in regard to marital status or household age structure.

High statistical significance differences were shown in the responses of different age groups according to all factors. Respondents in the age group 65+ had the highest value to the FH factor, the lowest values were within age groups 31-40 and 41-50 (F=4.687, p=0.000). Regarding SCEL factors, similar results were shown. Respondents within age groups <20, 21-30, 31-40 and 41-50 had the lowest values related to the SCEL factor, while age group 51-64 value it moderate and highest value was in the group 65+ (F=8.994, p=0.000), which is completely consistent with the differences according to LEB factor (F=4.094, p=0.001). When it comes to the LC factor, there was a gradual upward trend in the responses, from younger cohort having the lowest values to the oldest age cohort having the highest values (F=29.937, p=0.000).

According to the education, respondents with an incomplete elementary school gave the highest value to FH (F=2.937, p=0.02) and LEB (F=3.335, p=0.01) factors and a

gradual decrease with respondents having a doctorate.The analysis showed that socio-economic status is an important component for all four dimensions. Retired respondents gave highest value to the FH factor (F=4.665, p=0.003) and SCEL factor (F=10.489, p=0.000), while other categories gave lower values. Unemployed respondents gave lowest value to the LEB factor, while pupils and students had moderate values and highest values were for retired respondents (F=9.878, p=0.000). For the LC factor (F=33.420, p=0.000), values gradually shift from pupils and students with the lowest values to retired respondents the highest values.

The analysis revealed some differences between ethnic groups. Croats had the highest value to the SCEL factor (F=3.682, p=0.001), Bosniaks and "others" lowest, while Serbs had moderate values. Regarding the LEB factor (F=4.968, p=0.000) and LC factor (F=2.500, p=0.021), lowest value was for "others", moderate value for the Undeclared, Goranac, Bosniaks and highest value for the Croats, Hungarians and Serbs.

According to the number of household members, the values for the FH factor (F=10.651, p=0.000) gradually shift from lowest value for respondents within one-member households to highest value for those with many household members. The individuals who resided longest in a place are more likely to have developed significant relationships with other residents as well as with physical attributes of the place. The statistical significance and a certain pattern for all four dimensions (factors) were observed (FH: F=84.171, p=0.000; SCEL:F=37.701, p=0.000; LEB: F=5.448, p=0.000; LC:F=59.172, p=0.000). The values gradually shifts from lowest given by respondents who have lived less than 5 years in the current place of residence to highest for those with more than 30 years living in their current place of residence. The same situation was also shown regarding the duration of living in the same apartment or house, with high statistical significance for all factors (FH:F=49.108, p=0.000; SCEL:F=27.465, p=0.000; LEB: F=5.342, p=0.000; LC:F=29.063, p=0.000).

Discussion

The major objective of this study is to newer-evaluate place attachment concept applied to the population in Serbia, based on the well-established basic triple concept of person-process-place (Scannell & Gifford, 2010) but with some modifications and additions.

Factor analysis identified four groups of factors (Table 3), resulting in the creation of a four-dimensional place relatednessscale (4PRS). The first dimension is called *Family and Home – FH* and it refers to family, relatives and friends bonding, as well as growing up or a sense of belonging in one's home and family heritage. This dimension can be described as emotional and familial. This dimension is centered around the idea that individuals can form strong emotional connections with a place due to their close ties with family members. It highlights the significance of family relationships in shaping one's relatedness to a particular location. The presence of family members and the quality of these relationships can contribute to feelings of attachment, relatedness and belonging. Williams & Vaske (2003) noted that it could refer to a symbolic importance of a place as a repository for emotions and relationships that give meaning and purpose to life. Furthermore, this dimension can be explained as a component of self-identity that enhances self-esteem and increases feelings of belonging to one's place and community.

The second dimension is called *Social, Community and Everyday Life – SCEL* and consists of six components. This dimension refers to social and community bonding, which facilitates everyday life in the community and gives it meaning (school, chosen doctor, church, shops). It reflects the idea that individuals can develop a strong sense of attachment to a place based on their social and community relationships. It highlights the importance of social interactions, connections, and community bonds as key drivers of place attachment. This component underscores the vital role of relationships with neighbors, community members, and social networks in shaping attachment and relatedness.This paper employs the term 'community' with a particular emphasis on a systemic model that delineates interactions between residents and their neighborhoods. Individual connections to local social networks (bonds) and interactions with them are strongly related to community attachment according to this systemic model. Within this dimension, the concept of place attachment and relatedness extends to the meaningful aspects of everyday life within the community. It acknowledges that the place itself holds significance because it facilitates and enriches daily experiences. Elements such as schools, healthcare providers (chosen doctor), places of worship (church), and local shops play a crucial role in shaping individuals' experiences and attachment to the community.Social bonding, or feelings of belonging or membership to a group of people, as well as connections based on shared history, interests, or concerns, was also described by Perkins and Long (2002) and discussed by Alpek and associates (2022).

The third dimension is called *Local Environment Bonding – LEB*; it highlights the importance of connections to the (local) natural environment (parks, trees, air, places to walk and relax, seasons). It emphasizes the affective aspect by acknowledging the emotional bonds individuals form with the local natural environment. Additionally, it highlights the cognitive aspect by recognizing how individuals devel-

op a sense of rootedness and familiarity with the natural elements of their community. Place dependence says that the physical characteristics of a place are important to attachment and relatedness because they provide amenities or resources that help people achieve their goals and feel calm and safe. The places that people find meaningful include built environments like houses and streets as well as nature-based settings just mentioned. This setting is also noted by Raymond and colleagues (2010) who described place attachment in a natural environment context. In some way, this dimension could be explained as nature bonding at the local level. It is possible to classify this point of view using a framework that focuses on physical aspects of the place (resources), as well as the behavioral and cognitive expressions of the relationship that exist. This expression could be shown by staying close to places that provide food, water, shelter, and other resources, but also provide a sense of comfort and security.

The fourth dimension is called *Life Cycle – LC*, represents an additional dimension. The statements related to the life cycle were clearly identified in the analysis. As a result, they identify a fourth dimension, which encompasses all aspects and cycles of life, from work to raising a family to getting married to death. It is possible to include this dimension in other dimensions, but these features are so clearly identified that they really represent a complete life cycle; the mean values clearly show and confirm how important these components are for the respondents. The Life Cycle factor adds a temporal dimension, highlighting that the interplay between other factors can change as individuals move through different life stages.

Understanding the Life Cycle factor has implications for both research and practical applications. For research, it allows for a deeper exploration of how place relatedness can vary throughout a person's life and how these variations may be linked to specific life events. This factor may contribute to a more nuanced understanding of place attachment dynamics in different life stages. In practical terms, acknowledging the impact of life transitions on place attachment can inform urban planning, community development, and interventions to enhance well-being. For example, recognizing that young adults may have distinct attachment needs compared to retirees could lead to more targeted policies and initiatives.

Williams and Vaske (2003) suggest that future studies should look to other factors, such as social and demographic factors like age, sex, and education level. This work has shown and confirmed that certain demographic variables have a high or significant correlation with certain aspects of place attachment. All of the differences between the responses of people of different ages were statistically significant. Based on their education, people who did not finish elementary school gave FH and LEB factors the most weight. The analysis also showed that socioeconomic status is an important part of all four dimensions and that different ethnic groups place different values on some factors.

Birnbaum and colleagues (2021) noted that rural areas are different in terms of their central functions, demographic trends, economic dynamics, and remoteness which provide a specific basis for place attachment processes. This finding is also shown to be important, considering that rural respondents had higher values on FH and SCEL factors. Place-based identity is becoming more important in regional marketing and development to engage the people who live there which can be a driver for public participation and community engagement or to retain the qualities of a place (Manzo & Perkins, 2006).

Conclusion

Considering that place consists of interconnected physical and human components, a large number of studies on place attachment are justified. This research started by choosing existing and adding new items in order to re-evaluate place attachment concept and develop new scale, incorporating some additional insights. The practice for many people in Serbia is to change of their place of residence regarding the different stages of life cycle. However, it also depends on some other factors, such as ethnicity, tradition or environmental issues. This analysis is based on the 23 data features measuring the place attachment for 1059 respondents assessed on a five-point Likert scale. It clearly singled out four dimensions (*Family and Home – FH, Social, Community and Everyday Life – SCEL, Local Environment Bonding – LEB, Life Cycle – LC*) within a newly created four-dimensional place relatedness scale, called *4PRS*. The fourth dimension, Life Cycle – LC, represents an important additional component to this field of research because it has not been confirmed and validated in previous. This factor encompasses all aspects and cycles of life, from work, raising a family, getting married to death. Also, differences were tested regarding respondents' gender, age, education, socio-economic status, ethnicity, place of residence, households and duration of living in the current place of residence and current apartment or house in relation to 4PRS scale. High or important statistically significant differences were shown in the responses of different groups according to all dimensions (factors).

4PRS scale captures a broader spectrum of place-related experiences and relationships with one's place of residency. Main idea was to provide a more comprehensive understanding of the complex ways individuals connect

with their environment, beyond what is typically encapsulated by the term "place attachment." Place attachment is inherently multi-dimensional and can encompass various aspects, including emotional, cognitive, and behavioral connections. This new four dimensional scale includes objective rootedness, familiarity, emotional bonding, and life cycle and contribute to a deeper and more nuanced understanding of place attachment and place relatedness, reflecting its complexity.

This research confirmed that the place attachment concept needs to be constantly re-evaluated and tested in different places because people and the places they live change and so do their relationships. Different ways of life affect different parts of the place attachment in specific ways. Considering differences according to the type of settlement and age, future research needs to focus more specifically on place attachment features of rural respondents (about 25% in this study) and those 65+ years.

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Climate-Tourism Information Scheme (CTIS) for Sport Events from Past: Analysis of Cases of 1980 Summer Olympics (Moscow) and 2018 FIFA World Cup

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KEYWORDS

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ABSTRACT

This article provides a quantitative analysis of local climate-related factors that may influence the organization of large sport events in Moscow, Russia, and its graphic representation in form of CTIS (Climate-Tourism Information Scheme) with decade resolution for 1991-2021. The individual CTIS for two historical sport events with daily resolution were also done, and then compared to meteorological data recorded during two large sport events to assess the agreement between averaged and actual conditions, which was found to be good enough for CTIS to serve as basic evaluation method. The CTIS-difference with sport events in Moscow compared with cases of Doha and Tokyo seem to be more about identifying the time period with biggest thermal comfort frequencies, instead of looking for occurrences of heat stress conditions. According to 1980 Summer Olympics and 2018 FIFA World Cup events it can be noted that time period was planned satisfactorily.

Introduction

Climate change is an issue that has complex consequences for many facets of human life, including people's health (Townsend et al., 2003; Schneider & Mücke, 2021). It is especially relevant to sport, as it is directly impacted by natural environment and exhibits climate vulnerability at different levels: from the process of organizing the event itself to the condition of individual athletes (Orr & Inoue, 2019). The most common concerns for such events seem to be the heat impact on athlete and spectator health, the heat impact on the athletic performance, and suitability of various cities for sport events hosting (Orr et al., 2021).

Sport-specific health risks caused by the climate change may be direct and indirect (Schneider & Mücke, 2021). In case of direct health risks, the main cause of damage is the prolonged exposure to very high temperatures. Generally, physical exercise combined with high temperature and air humidity imposes a significant strain on human body system and compromises thermoregulation system (Brotherhood, 2008; Hanna et al., 2011), as high humidity levels prevent cooling of the body through sweat evaporation thus causing the heat to remain in the body (Maloney & Forbes, 2011). Even though the well-trained athletes have an individual tolerance to increases in core body temperature (Hanna et al., 2011), they still may be vulnerable to exertional heat illnesses (EHI) and exertional heat strokes, the latest listed as the third highest cause of death of athletes during physical activities (Mallen et al., 2022), while the number of reg-

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istered EHI deaths has significantly increased in the last three decades (Gamage et al., 2020).

Therefore, information about meteorological and climate conditions, including the ones that influence the level of the thermal stress experienced by human body, is highly relevant for the participants and spectators of sport events. With the latest large sport events, such as 2020 Summer Olympics and 2022 FIFA World Cup, being held in location with high probabilities of extreme daytime temperatures (Japan and Quatar respectively), this problem came to the forefront of biometeorological research. The general climatological conditions of Tokyo Olympics expected to be hottest ever were evaluated in (Gerret et al., 2019; Kakamu et al., 2017; Matzarakis et al., 2018), as well as heat exposure at some Olympic event venues, such as the marathon (Honjo et al., 2018; Vanos et al. 2019). Similar research was conducted for Doha, where the 2022 FIFA World Cup was held (Sofotasiou et al., 2015; Matzarakis & Frohlich, 2015). Some of them, for example, (Olya, 2019), made calls for a change in approach to planning sport mega events as part of adaptive strategy toward climate change.

In recent years, the effective methodology for such evaluation, employing mean an extreme climate conditions of the area, was developed (Matzarakis, 2014). It allows to identify the most appropriate period of the year, as well as to present it in the easily accessible way for interpretation by non-experts in terms of climatology, which usually serve as decision-makers on different administrative levels. It requires appropriate data series with high temporal resolution, which can illustrate the patterns of change of all relevant parameters throughout the year. This methodology had been applied to the Tokyo Olympic Games (Matzarakis et al., 2018, 2019), which were held at open air in summer, as well as to the case of FIFA World Cup of 2022 in Doha (Matzarakis & Frohlich, 2015), which originally had been planned for summer too. Similar analysis was also conducted for the upcoming Paris Olympic Games in 2024 (Matzarakis & Graw, 2022).

Therefore, the aim of this paper is to assess suitability of background meteorological conditions for outdoor sport events, including human thermal comfort, for Moscow, Russia. Specific attention was paid to summer thermal comfort conditions in the city, for the increase in surface temperature of this season and the frequency of heatwaves in European Russia is well-documented (Vyshkvarkova & Sukhonos, 2023). Additionally, Moscow is a largest megacity in Europe, made more vulnerable to heat wave events by the urban heat island effect (Kislov & Konstantinov, 2011; Kuznetsova et al., 2017; Varentsov et al., 2019). The previous research on bioclimatic conditions in Russia (Vinogradova, 2021) and its largest cities (Konstantinov et al., 2021) also indicates the increase on frequency of thermal stress conditions in summer months.

The detailed results presented in accessible graphic form may be employed in long-term planning concerning organization of different open-air events in that specific location. This assessment methodology has also been applied to the large sport events held previously in the city: Moscow 1980 Olympic Games, and FIFA World Cup of 2018. The comparison of the most appropriate time periods according to chosen method and existing dates of events was conducted.

Data and methods

Moscow-VDNH meteorological station (WMO station ID 27612) is located in the northern part of Moscow (55.8°N, 37.6°E, 156 m).

The city itself has the area of 2511 km², and the population of 13,1 million inhabitants within its administrative borders. The climate of Moscow is continental and characterized by warm and humid summer with cold, dryer winter (Dfb Köppen climate zone) (Peel, 2007). The annual average temperature is 5.5 °C, and the annual sum of precipitation is 690 mm (Figure 2). The warmest month is July, when average temperature reaches 18.2 °C, and the coldest month is January with an average temperature of -9.3 °C. Monthly average of precipitation is highest in July (94 mm), and the driest month of the year is March (34 mm).

The assessment of human thermal comfort requires the calculation of thermal indices (Matzarakis et al, 2007). There are more than 170 such indices (de Freitas & Grigorieva, 2017), and most of them require data on air temperature and air humidity for calculation. Studies like (Grundstein et al., 2013,

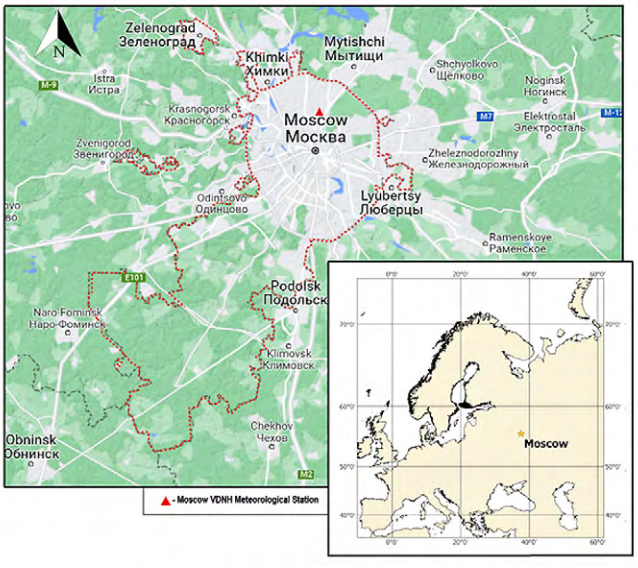

Figure 1. Location of Moscow

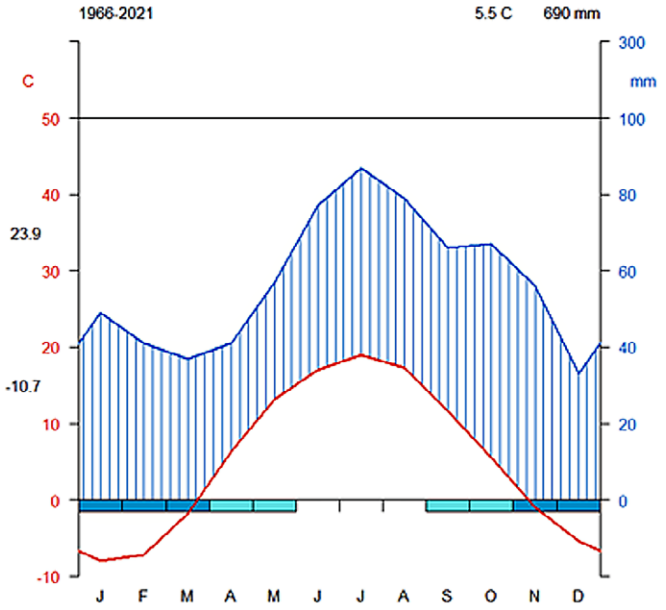

Figure 2. Walter and Lieth diagram for Moscow. Red line represents mean monthly averages of air temperature, blue line – mean monthly sum of precipitation for the period 1966-2021. Blue vertical lines exhibit humid conditions

2023; Gerret et al, 2019) have suggested to use wet-bulb globe temperature (WBGT) index for evaluation of thermal stress during sport activities. WBGT values demonstrate the cooling rate of human skin through surface evaporation. However, to better account for the complexity of heat exchanges in the human body – environment system, thermal comfort indices based on human energy balance model (Höppe, 1993) were used in this study. They combine the physiological aspects of the human body with appropriate meteorological parameters, such as air and surface temperature, humidity, wind speed and cloudiness which influences radiation fluxes in the environment. For evaluation of overall thermal comfort, the Physiological Equivalent Temperature (PET) was calculated (Höppe, 1999).

PET is defined as the air temperature at which, in a typical indoor setting (without wind and solar radiation), the energy balance of the human body is balanced with the same core and skin temperature as under the complex outdoor conditions to be assessed (Höppe, 1999; Matzarakis et al, 2007). This index has many advantages; however, one particular is that degrees Celsius (°C) are used as a unit of measurement for PET, which makes it easily digestible for non-professionals, and allows the comparison to similar studies.

The RayMan model was applied for the analysis of thermal comfort conditions throughout the year. It is a micro-scale model developed for calculation of radiation fluxes in different environments (Matzarakis et al, 2007, 2010). The resulting PET was divided into nine well-known classes of thermal perception.

In this research, meteorological data with standard 3-hour resolution (WMO station 27612) was used, except for sums of precipitation and for snow cover with daily resolution. In order to get more relevant results, the data utilized was mainly for the period from 1991–2021, which represents current climate of the area. However, for evaluation of the meteorological conditions during Moscow Summer Olympics in 1980, additional data for 1961–1990 was separately included to get information on mean and extreme climate conditions of the previous 30-year period.

Climate information was presented using CTIS (Climate-Tourism Information Scheme) (Matzarakis, 2014), which provides frequency of extreme weather conditions (including thermal comfort) that exceed chosen threshold criteria throughout the year with appropriate frequency classes. CTIS may have different resolution, depending on the characteristics of available data. For purposes of this study, yearly conditions were presented in decades. The selection of factors included in CTIS was based on climate of the study area.

Threshold criteria have been selected according to literature references. For thermal Moscow, the following threshold criteria have been used: thermal comfort (13°C < PET ≤ 29°C), heat stress (PET > 35°C) cold stress (PET ≤ 8°C), foggy days (relative humidity > 93 % between 6 and 18 h., local time), wet days (daily precipitation sum > 5 mm), dry days (daily precipitation sum <1 mm), sultry days (water vapor pressure > 18 hPa) (Matzarakis, 2007). The criteria for sunny days (cloud cover < 5 oktas between 6 and 18 h., local time) and stormy days (wind speed > 8 m/s) were chosen according to (Gómez-Martín, 2004). Threshold criteria for snow days was snow cover exceeding 10 cm, which is considered enough for cross-country skiing in non-alpine regions (OECD, 2007; Neuvonen et al., 2015).

However, several of these factors give positive contribution to overall comfort, and some – negative. Therefore, to get one suitability scale, all rows save for frequencies of thermal comfort conditions and sunny days have been inverted. The frequencies of extreme weather conditions were expressed via color-coded 5 % probability classes that range from "unsuitable" (red on the diagram) to "ideal" (green on the diagram).

Results

Thermal conditions in Moscow throughout the year have been described mainly using PET thermal index, which provides averaged thermal perception and grade of thermal stress in decade resolution for 1991-2021. Same has been done for precipitation, which is another important factor for open-air events. The annual distribution of both has been visualized on frequency-distribution plots that show the probability of each class of PET and daily precipitation throughout the year.

In general, year in Moscow is dominated by classes of PET <13°C, which indicates high probability of cold stress conditions. The probability of PET ≤4°C (extreme cold stress) exceeds 90 % from mid-November to the second decade of March, and the probability of extreme cold stress conditions occurring is close to zero only in late July and early August. Classes of PET that indicate cold stress conditions, from strong to moderate, occur throughout all year. Thermal comfort conditions can be found in summer

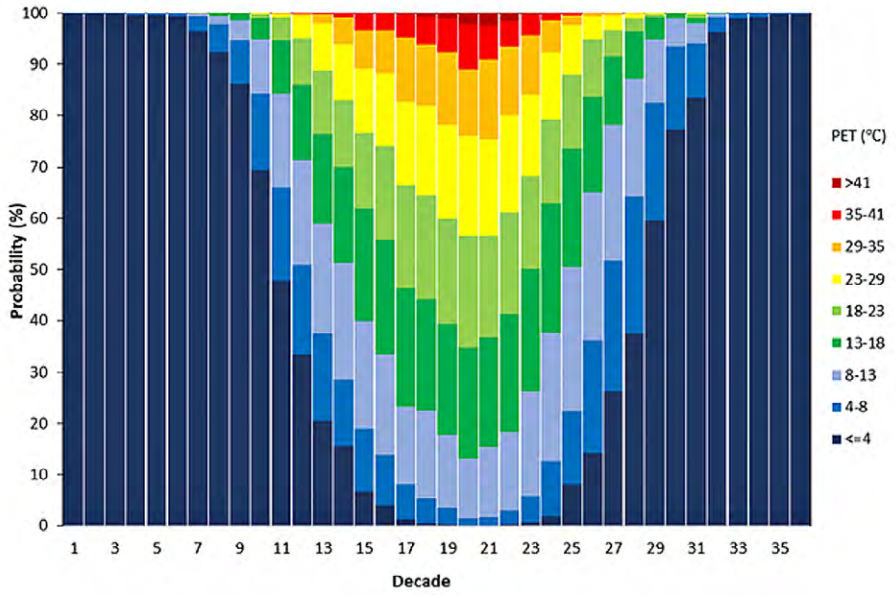

Figure 3. Frequency diagram for the occurrence of PET classes for Moscow in each decade in 1991-2021 (3-hour resolution)

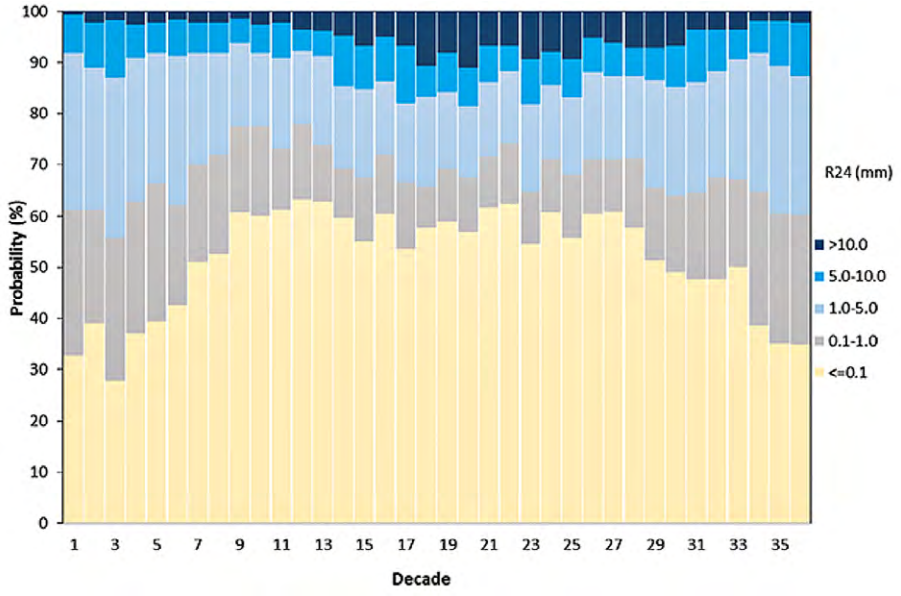

Figure 4. Frequency diagram for the occurrence of precipitation classes for Moscow in each decade in 1991-2021 (daily resolution)

months, from early June to the second decade of August. Its probability is highest in the second decade of July (22 %). Heat stress conditions (PET > 35°C) mostly occur from late May to the end of August, and their probability barely exceeds 10 %. Maximum heat stress is characteristic for July and first decade of August, and probability of PET > 41°C in that period ranges from 1.5 to 3 %.

Precipitation in Moscow is regular throughout the year. Winter months are distinguished by the higher probability of light precipitation. Dry days occur more frequently in summer months, and the heavy rain evens follow similar pattern. Probability of such events reaches 10 % in that period, mainly due to more intense daytime convection.

The Climate-Tourism/Transfer-Information-Scheme created for Moscow reveals a few interesting patterns. In terms of thermal comfort (the first row on Figure 5), the most suitable conditions mainly confined to the period from June to August, and throughout July and early September the conditions are in "suitable" range (frequency > 55 %). Their frequency is also up to 40 % in May and first decade of June. The cold stress conditions are characteristic for period from October to April, and since 21.10 to 20.03 the frequency of their occurrence is close 100 %, and it renders these months less suitable for holding open-air events. On the other hand, heat stress conditions occur most frequently in summer months, especially in mid-July (13 %).

Sunny conditions are quite rare throughout the year in Moscow. The most suitable conditions can be found from middle of July to the end of August, with probability reaching 45 %. Least favorable are months from November to January. Consequently, foggy days are characteristic to colder season, and warm season is dominated by dry days instead. Wet days are also more frequent in June-August due to higher probability of convective precipitation. Stormy days are rare throughout all seasons and do not demonstrate any digestible patterns. Finally, snow days occur with highest probability from November to March.

The 1980 Summer Olympics and FIFA World Cup were the large sport evens that were used to assess the agreement between CTIS diagrams and meteorological data from the station.

The 1980 Summer Olympics were held in Moscow from July 19th to August 3rd, 1980 (Figure 6). For the specific time

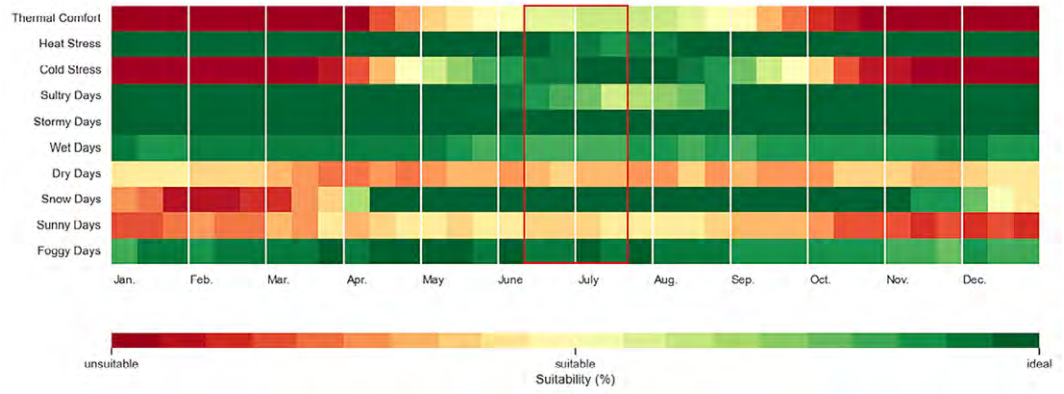

Figure 5. CTIS (Climate-Tourism/Transfer-Information-Scheme) demonstrating averaged frequency of occurrence by decades for relevant parameters in Moscow for the period 1991-2021. The red box highlights time of FIFA World Cup, 2018

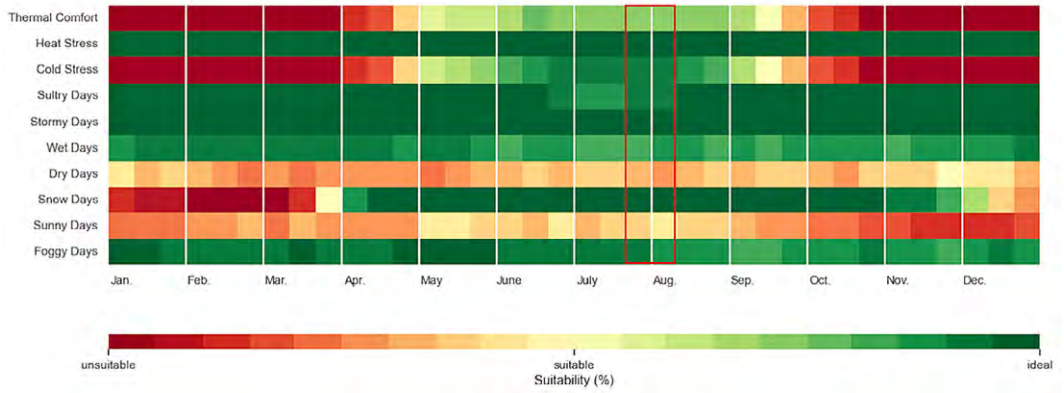

Figure 6. CTIS (Climate-Tourism/Transfer-Information-Scheme) demonstrating averaged frequency of occurrence by decades for relevant parameters in Moscow for the period 1961-1990. The red box highlights time of the Moscow Olympics, 1980

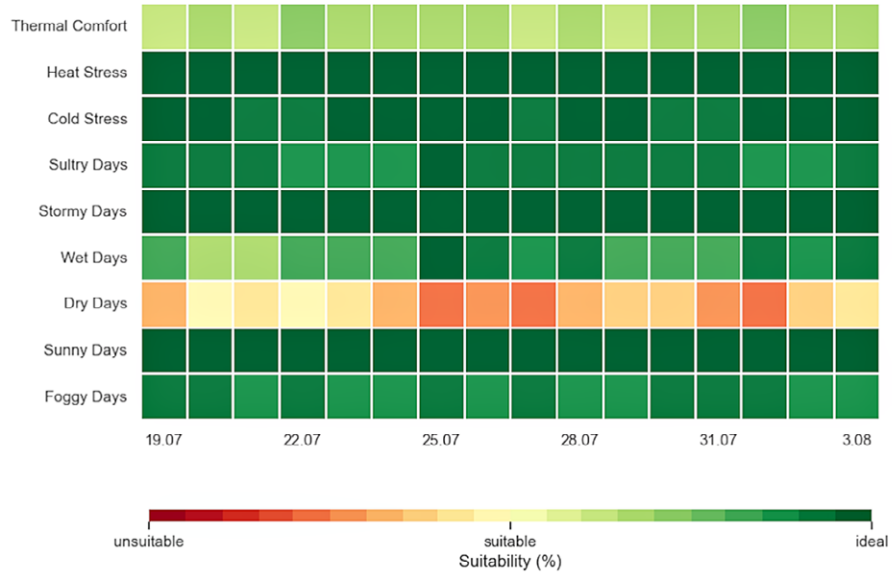

Figure 7. CTIS (Climate-Tourism/Transfer-Information-Scheme) demonstrating averaged frequency of occurrence by individual days of the year (19.07-3.08) for relevant parameters in Moscow for the period 1961-1990

of the Olympic Games, CTIS indicates a well-selected period in terms of heat and cold stress, as well as snow and stormy days. Probability of thermal comfort conditions occurring is within "suitable" range too. Sunny days are less frequent in the chosen period; however, it is characteristic for Moscow throughout the entire year. In terms of frequencies of wet and sultry days, the decades also may be considered suitable, and the probability of thermal comfort conditions worsening due to air humidity is not high.

CTIS with daily resolution for specific days of Moscow 1980 Olympics (Figure 7) indicates similar patterns, with all parameters except for dry days (row 8) being in "suitable" or "ideal" range.

For specific days of the Olympics, daily distributions of PET and precipitation classes were also illustrated (Figure 8, 9). The daily distribution of PET is dominated by slight cold stress, thermal comfort, and slight heat stress conditions, which occur in that order from nighttime to daytime. Probabilities of moderate or strong cold stress conditions does not exceed 10 %, and for moderate and strong heat stress the frequency of occurrence is less than 15 % too. For precipitation classes, frequency of days with sum

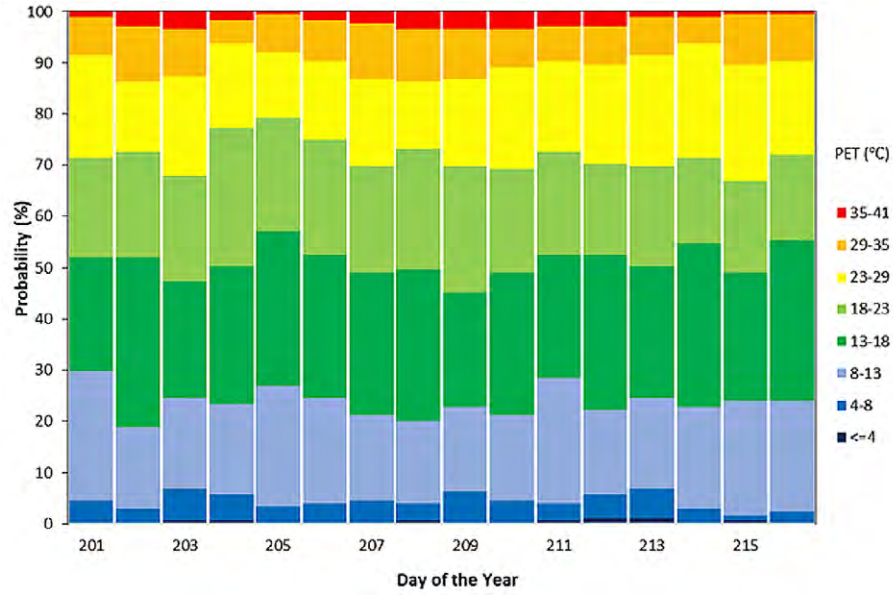

Figure 8. Frequency diagram for the occurrence of PET classes for Moscow by individual days of the year (19.07-3.08) for the period 1961-1990

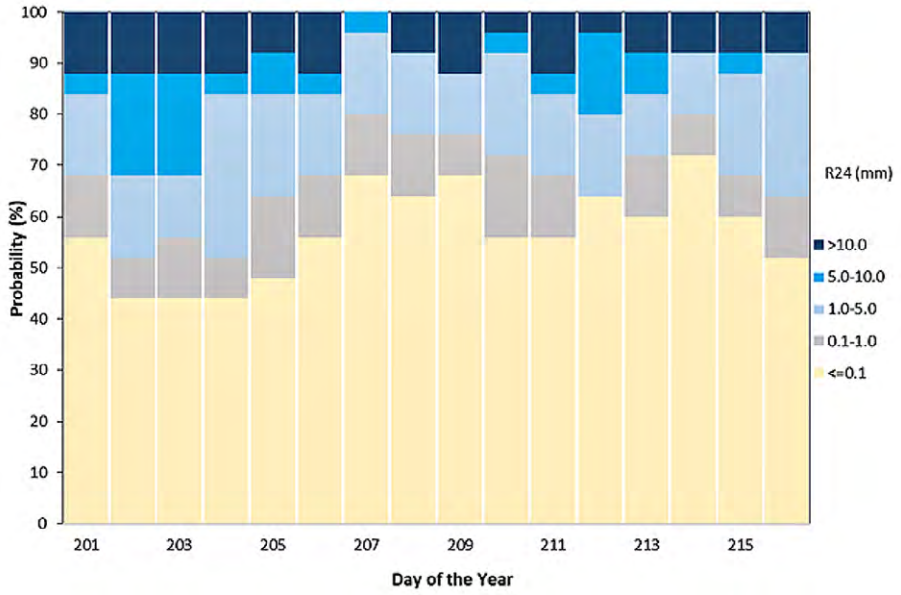

Figure 9. Frequency diagram for the occurrence of precipitation classes for Moscow by individual days of the year (19.07-3.08) for the period 1961-1990

of precipitation less than 1 mm is highest and reaches more than 70 %.

When analyzing the observed meteorological conditions during 1980 Olympics, the days in which threshold criteria were exceeded in general are consistent with CTIS for the same period (Figure 7). For example, it reflects the higher probability of precipitation on 20.07, as well as more likely occurrence of sultry conditions on 24.07. However, there seem to be inaccuracy in evaluation of the parameter of cloudiness which may be attributed to the methodology of the research.

In recent years, Moscow had also been a host of FIFA World Cup which took place from June 14th to July 15th, 2018 (Figure 5). Despite the observed climate change, CTIS also indicates a well-selected time period for the World Cup, similar in its basic characteristics for the time period of the summer Olympics described above, although the probability of cold stress conditions occurring in June is slightly higher, and the probability of thermal comfort conditions, therefore, lower.

CTIS with daily resolution for relevant days also demonstrates a similar pattern of all evaluated parameters being in "suitable" or higher range, except for dry days probability which in the "unsuitable" range of several occasions.

Daily distribution of PET and precipitation classes for FIFA World Cup of 2018 are demonstrated on Figures 11, 12. PET daily distribution consists mostly of slight cold stress, thermal comfort, slight heat stress and moderate heat stress conditions, the latter becoming noticeably more frequent in comparison to the 1966-1990. Probability of strong heat stress conditions, mostly confined to afternoon hours, on some days of July exceed 10 %, and the probability of extreme heat stress conditions (extreme-

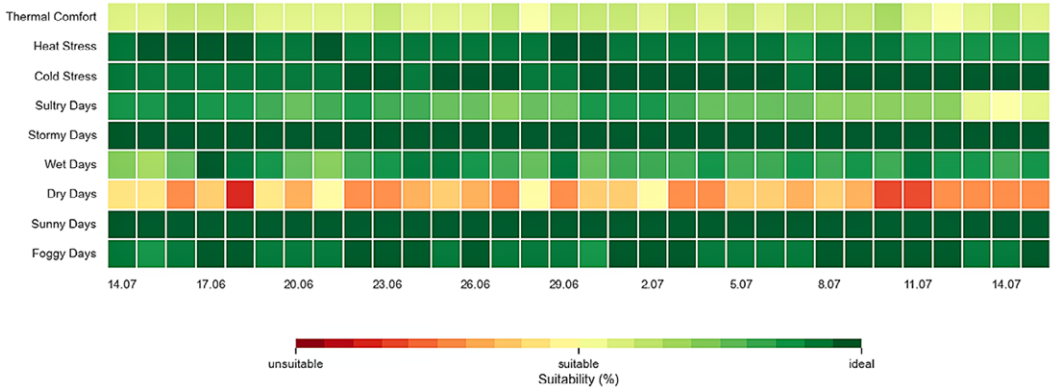

Figure 10. CTIS (Climate-Tourism/Transfer-Information-Scheme) demonstrating averaged frequency of occurrence by individual days of the year (14.06-15.07) for relevant parameters in Moscow for the period 1991-2021

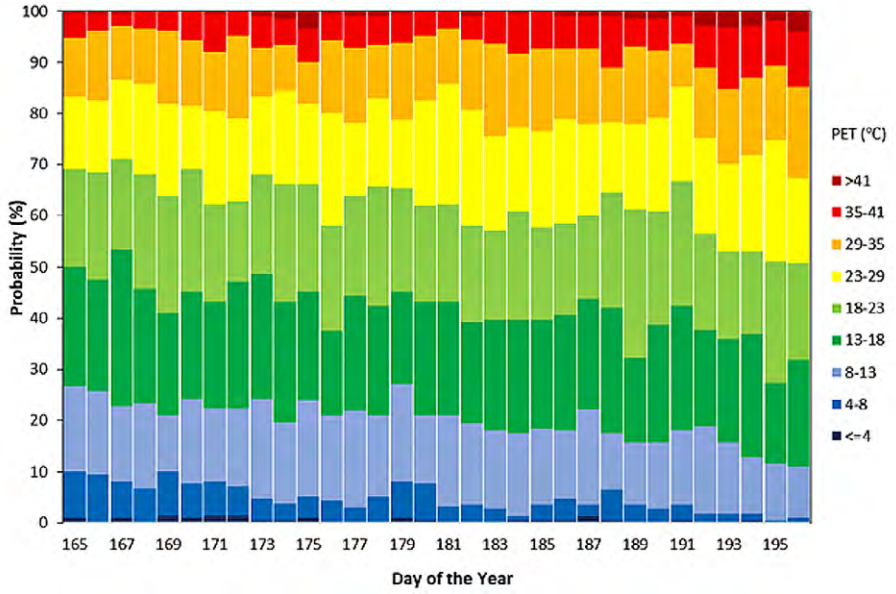

Figure 11. Frequency diagram for the occurrence of PET classes for Moscow by individual days of the year (14.06-15.07) for the period 1991-2021

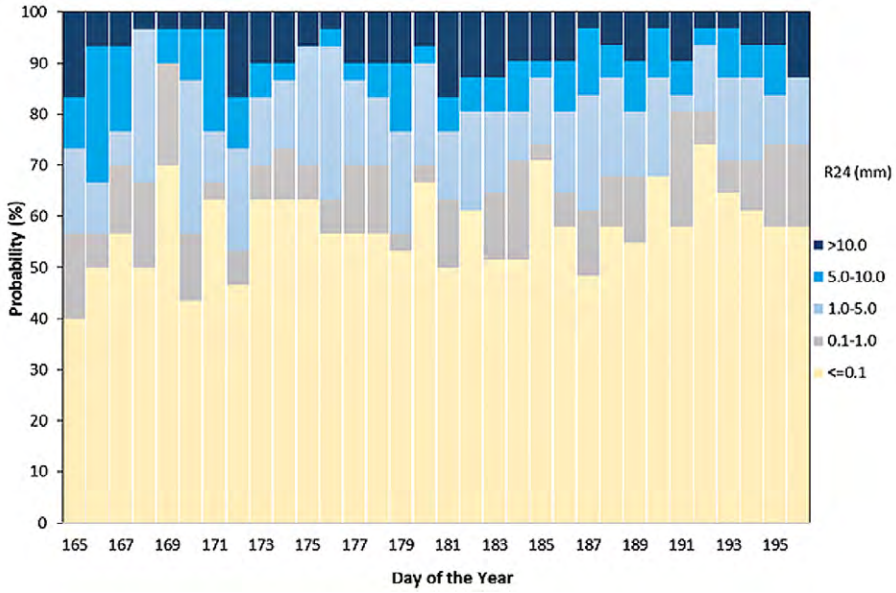

Figure 12. Frequency diagram for the occurrence of precipitation classes for Moscow by individual days of the year (14.06-15.07) for the period 1991-2021

ly rare for previous 30-year period) occurring also exceed 2 %. The daily distribution of frequency for different precipitation classes is dominated by dry conditions with less than 0.1 mm of precipitation and precipitation in range from 1.0 to 5.0 mm per day.

CTIS (Figure 5) in general reflects the observed meteorological conditions during 2018 FIFA World Cup. As with Moscow Olympics described above, CTIS describes the precipitation probability most accurately, reflecting the actual occurrences of it with daily resolution. Cloudiness evaluation remains the least accurate of the parameters.

Discussion

Comprehensive evaluation of meteorological conditions for open-air events, including sports, is impossible without methods of biometeorology and tourist climatology (Matzarakis, 2014), which can be used to quantify data on thermal stress and to combine it with other parameters that influence perception of comfort of the environment (Top et al., 2020; Geletic et al., 2018; Giannaros et al., 2018). The selection of these should include thermal comfort index (PET, UTCI, mPET) and other individual parameters that describe, for example, distribution of precipitation throughout the year in accordance with specifics of the local climate (Pochter et al., 2018). However, the application of this research requires a presentation of the findings in intuitively understandable and easily assessable way (Matzarakis & Frohlich, 2015; Matzarakis & Graw, 2022; Milosevic et al., 2023).

Therefore, the CTIS schemes with different time resolution, which require only highly available meteorological data from on-site stations, appear to be the most practical way of doing so. It can provide information for all kinds of tourist activities in the area, including large events which require throughout strategic planning, especially in relation to possible risks and negative impact of different conditions, including climate.

Results for Moscow for period 1991-2021 show the expected rise in the probability of thermal comfort conditions in summer months and its decline in the cold season, as well as quite high frequency of occurrence of cold stress conditions throughout the year, with heat stress conditions being confined mostly to July and August. The CTIS also accurately represents the higher probability of dry days in warm season and wet days in cold, which is a characteristic feature of Moscow climate.

Time periods chosen for 1980 Moscow Olympics and FIFA World Cup demonstrate suitable conditions in terms of thermal comfort availability back then (Figure 4, 5, 6, 9). The frequency of heat and cold stress conditions occurrence in these periods was also low. The probability of the sunny weather, another limiting factor for open-air events, is close to ideal too. The most probable cause of discomfort could have been the combination of heat stress conditions with sultriness and heavy precipitation; however, the observation data reports that it wasn't the case. The CTIS diagrams with daily resolution for both events demonstrate good agreement with observation results, accurately predicting possibility of wet and sultry conditions on specific days.

Compared to the cases of Doha (Matzarakis & Frohlich, 2015) and Tokyo (Matzarakis et al., 2018) CTIS for sport events in Moscow seem to be more about identifying the time period with biggest thermal comfort frequencies, instead of looking for occurrences of heat stress conditions, as the city's geographical location accounts for far colder climate. Therefore, even in summer period, the frequencies of cold stress conditions surpass them for heat stress and may present a bigger obstacle, although the one with less severe consequences for health in May-September.

This research provides an easily digestible results which can be applied to many sectors of the economy, not only management of sport. The frequency-based approach also helps to minimize the distortions which may appear in case of approach based on calculation of average for a variable. The assessment of thermal comfort through PET allows the incorporation of many meteorological parameters that may influence human health. The comparison of CTIS frequencies to observation data also indicates the agreement between them which validates this approach for planning of future sport events. However, CTIS diagrams are based on the data of representative meteorological station, therefore the evaluation for specific locations of sport events still requires more computationally expensive methods such as microscale modelling. As described above, the accuracy of CTIS relative to observation data differs for different meteorological parameters.

Conclusions

Proposed variant of CTIS provides the easily accessible information on basic climatological conditions in the research area, making it a valuable asset for decision making on different administrative levels. The inclusion of the biometeorological facet using thermal comfort indices specifically, allows for planning which addresses negative impact heat or cold stress may have on participants, especially athletes. The comparison of CTIS frequencies with meteorological observation data indicates the agreement between them, which proves it to be a good baseline for assessment of climate conditions when it comes to planning major events. In terms of managing future sport events, CTIS provides a tool for micro-managing their time frames, which generally tend to be well-placed in terms of combination of climate factors (due to familiarity with local conditions) and require assessment in 10-days or less resolution. These diagrams may also be adapted by local communities for tourism management purposes as they show the most favorable conditions for potential visitors.

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