A Sentiment Analysis of User-Generate Contents Proximate to the Polish Rivers

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Introduction

The scholarly interest in pursuing research at the intersection between societal and water issues has increasingly driven international policy applications to tackle the complex societal challenges (Wiegleb & Bruns, 2018). As such, SDG6 -Ensure availability of clean water and sanitation for all- is recognized as the "essence" for society's wellbeing, ending hunger and poverty, achieving food security and improving nutrition (UN, 2018).

Rivers build societal foundations by connecting people, and places, inspiring outdoor leisure such as bathing, fishing, or sailing. Rivers elevate landscape appeal that a destination can depend on (Lootvoet and Roddier-Quefelec, 2009). Hereafter, a range of tourism activities have been built up around rivers as the "sparkle in the jewel of landscape" (Patmore, 1983, pp. 205): e.g., river tourism, sun and sea, spas, health and wellbeing, active leisure and adventure tourism. While the literature has overlooked the river-wellbeing and river-spiritual linkages (Anderson, 2019), rivers connection to public mental health may be especially pertinent during emergencies like the Covid-19 pandemic when anxiety, commotion in every aspect of life, and physical health have been significantly worsening during the lockdowns (Helliwell et al., 2021). While public is more aware of the nature and the environment in general during the Covid-19 crisis (Rousseau & Deschacht, 2020), the increasing pressure on natural resources, visiting capacity, and the emotion of visitors during their visits remain uncharted.

We employed sentiment analysis of user generated contents (UGCs) to better understand patterns of visits and sentiment expressed in the textual data before and during Covid-19 pandemic in Poland. This approach is considered "highly relevant" for tourism research and has been gaining momentum recently (Kirilenko et al 2018; Ribeiro et al. 2016). UGCs like those on Instagram are a unique source of data to evaluate how people view and value environment in their nature encounters. Social media offers spatiotemporal insights with details of visitors' movement, types of activities, temporal patterns, and emotions. In this regard, the bigdata generated from the geotagged photos posted on social media contains coordinated information, captions, tags, and time, along with other complementary textual metadata that facilitate flow of spatial and temporal analysis to tell insightful stories (Ackoff, 1989). Moreover, sharing the experiences in public generates an overall destination image that may fundamentally transform the way people travel (Fatanti & Suyadnya, 2015). Nevertheless, such information can bundle as a way to monitor the experiences, visiting patterns, and emotional states captured on-the-spot (Pocock et al., 2009).

While User-Generated Content (UGC) has become the focus of many studies in tourism and recreation research (Sun et al., 2020), research on different stages of spatiotemporality is lacking, particularly in the context of nature-based visitor experiences.

With this presentation we aim to answer two questions:

1- How can we use the UGC data to better understand the societal impact of visiting river before and during Covid-19 pandemic?
2- How has development of COVID-19 pandemic corresponded with the sentiment of the those visiting rivers in Poland?

To that end, we carried out a content analysis for all the flowing rivers of Poland: first of the public Instagram pages based on location, and then of the relevant hashtags for each river, exposing User-Generated Content (UGC) through the visitors' lens to understand a basic cultural hegemony, the patterns of visit, and the moods of visitors. The results of this study, assist in the articulation of patterns and moods proximate to the river, provides unprecedented practical insight, and illuminate path for further research.

Literature Review

Interest in nature-based tourism and outdoor recreation is ascending in rural areas, where their social and economic priorities may exceed that of other livelihoods (Butler, 2014). On the other hand, protecting rivers and the ecosystems is essential for the wellbeing of societies in Europe (Parker & Oates, 2016). The stakes are high and responsibility for nature has become a new guiding principle of everyday practice (Steffen, 2007). The Water Framework Directive (WFD) radically changed the legal importance of surface and underground water. It highlights, that protecting rivers and the ecosystems in which they traverse facilitates health and viability of the rural landscape of Europe. Rivers are special elements of larger ecosystems associated with numerous services. Competition between cultural and infrastructure uses of rivers affects aesthetics and access, and as such, rivers can be subjects of vivid policy and political conversations (Tickner et al, 2017). In this picture, river sites are places where people can come for rest, relaxation, refreshment or recreation (de Groot et al., 2002).

The rapid pace of technological changes and inclusion of big digital data as a source for researchers and practitioners facilitate simultaneous production and consumption of information (Sigala, 2016) to co-create the experience. Social media posts considerably affect the destination choices among the users, becoming one of the major push-factors in destination promotion (Hanan & Putit, 2014). Tapping into these large volumes of data may help managing the current high demand for experiences in nature (Luck & Aquino, 2021; Soteriades, 2012).

Despite the increasing complexities to collect data from online platforms (Maletic & Marcus 2009), Instagram has been gaining in position due to its special photo-metatag features and it is projected that the number of studies conducted on it will continue to grow (Nixon et al., 2017). To date, most studies in this field have focused mainly on destination management, branding, promotion, and marketing (e.g., Yu et al., 2020), changing visitors' perception (e.g., Shuqair & Cragg, 2017) or engaging visitors (Kusumasondjaja, 2021). However, Instagram's usage to understand the sentiment and spatiotemporal activities of the users in a natural setting remains intact. Visitors' social media posts can mirror feelings such as happiness or disappointment (O'Leary, 2011). While emotions and place affection are acknowledged as vital factors in decision-making (Li et al., 2017), tourism and recreation studies on sentiment analysis are still scarce (Lu & Stepchenkova, 2015).

Methodology

Despite the theoretical underpinnings alluding the benefits of using UGC, analyzing such big data in a way that generates a meaningful story has been rare in tourism domain. In a sense, the

massive volume and variety of the big data sets (i.e., textual) extend beyond the scope of conventional analytical tools commonly used in tourism research. In pursuit for the best method of interpreting the social network data, many scholars scratched only the surface of the textual big data to offer travel recommendation systems (e.g. Kurashima et al., 2013), visitors trajectory patterns (e.g. Chua et al., 2016) or tourist demand models and market profiling (e.g. Supak et al., 2015). Sentiment analyses are technically complex as they combine many factors such as natural language processing, statistics, and machine learning (Alaei et al., 2017). One issue concerning the sentiment analysis, is the use of 'lexicon-based' approaches to annotate a sentence. Recently, Kirilenko and colleagues (2018) found that a human rater could perform better than many of the sentiment analysis tools specially in complex and noisy datasets. However, relatively less research focused on sentence-level analysis, for the complications of accurately extracting polarity from limited number of words compared to longer users' reviews (Ribeiro et al. 2016). A key concern here may be on how 'polarity' is translated in majority of these studies as a binary classification of the sentiments into "positive' and 'negative' (Bjorkelund et al., 2012; Shimada et al., 2011). While the studies mostly used the sentiment measurement on positive or negative tendency from a neutral point, a fuzzy-based (Zadeh et al., 1996) approach has been rarely reflected in tourism research to understand the intensity of these sentiments. The method moves beyond the binary classification towards a set-theoretic approach with ranges between [1,0]. Thus it can facilitate a range for sentiment to rate the textual data. In line with the guidelines of Miah and colleagues (2017) that propose a method to differentiate the social media big data into different aspects, our solution for the methodology combines three computational techniques i.e. text processing, spatial clustering, and temporal modelling to investigate visitors' spatiotemporality of sentiments on the river sites.

Data collection and process

Weber's (1990) content analysis guideline is useful to evaluate social media data, as it acknowledges researchers to distillate inferences from captions, tags, or metadata connected to visual information. Content analysis is applied for understanding context in the textual data, as it facilitates to manifest content through the direct observation of visitors as well as examining additional entries embedded in the message. Data collection, screening, filtering and cleaning, evaluation, and understanding of the findings are the major steps applied in relation to social media data analysis in tourism (Schmunk et al. 2014).

To proceed, first, we prepared a list of all rivers flowing throughout Poland, then, we searched the Instagram for the location (including name or geographical location) to fetch all relevant photos and metadata for each river. In the second step, we used all hashtags including name of the river or/and name of the river following/preceding the phrase 'River' in English and Polish language as well as different conjugations to fetch photos along with their metadata into each rivers' category. The data was retrieved directly from Instagram platform during September 2021 to January 2022. The ethical issues concerning the privacy and anonymity of the users was regarded while downloading the data with public accounts only. After a thorough data screening for each river, and filtering out the photos unrelated to the location, in total 297,798 photos along with their metadata have been retrieved from 500 rivers flowing in Poland. Next, we used a combination of tools such as Python and Microsoft Azure cloud computing, natural language processing (NLP), and machine learning (ML) to analyse the data.

Results

Cultural hegemony

Table 1 reflects languages of posts from visitors based on natural language processing to determine the medium language of the Instagram users. Most of the visits were made by Poles following by English, Slovak, German, and Russian speakers. This result reflects language hegemony of Instagram posts corresponding to rivers in Poland.

Table 1. Origin of the visitors

Language	Count	Percentage
Polish	237028	79,59%
English	52549	17,65%
Slovak	1414	0,47%
German	1136	0,38%
Russian	1097	0,37%
Italian	626	0,21%
Czech	563	0,19%
French	445	0,15%
Spanish	373	0,13%
Thai	264	0,09%
Korean	238	0,08%
Indonesian	178	0,06%
Ukrainian	161	0,05%
Hungarian	159	0,05%
Dutch	153	0,05%
Japanese	143	0,05%
Swedish	109	0,04%
Portuguese	104	0,03%
Others	1058	0,36%
Total	297798	100

Text processing and Sentiment Analysis

The textual meta-data of geotagged photos often contains specific keywords or captions, which may replicate priorities or visitors' interests or motivations while taking the photos. However, such textual data is largely unstructured, making it unsuitable for analysis without some form of pre-processing. It is vital to employ a powerful text processing tool to examine huge to extremely huge amount of unstructured data with (see, Feinerer, Hornik & Meyer, 2008) that supports several language databases (English or Polish, etc.) and exhibits a comprehensive list of vocabularies for the descriptions of interests or analysis of sentiments. Then, a sentiment analysis feature returns a fuzzy confidence score between [0 , 1] for each caption providing further translation of data into positive, neutral and negative sentiment. We calculated the result for the average scores of sentiments for highly visited rivers listed in Table 2, however, this process can determine further analysis such as opinion mining that is beyond the scope of this paper.

Table 2. List of mostly visited rivers along with the average sentiment score from visitors

River Name	Latitude	Longitude	Number of photos	Average Score Sentiment
Motława	54°21’37”	18°39’50”	29253	0,71
Wisła	54°21’42”	18°57’07”	23480	0,71
Świder	52°07’13”	21°11’51”	16187	0,71
Wkra	52°26’45”	20°44’43”	12523	0,71
Dunajec	50°14’33”	20°43’43”	11901	0,7
Warta	52°35’55”	14°36’37”	11633	0,69
Odra	53°36’19”	14°35’20”	9885	0,69
Liwiec	52°36’03”	21°33’29”	9301	0,66
Wisłok	50°12’22”	22°31’58”	8817	0,71
Bug	52°32’00”	21°15’12”	8644	0,7
Łyna	54°21’06”	21°01’09”	8307	0,7
Rawka	52°08’32”	20°06’44”	5443	0,69
Narew	52°26’00”	20°40’32”	4832	0,69
Tanew	50°29’35”	22°15’27”	4790	0,67
Drwęca	52°59’57”	18°41’26”	3987	0,7
Prosna	52°08’31”	17°39’45”	3767	0,7
Gwda	53°03’18”	16°43’33”	3729	0,67
Parsęta	54°11’18”	15°33’04”	3641	0,67
Brda	53°07’25”	18°08’03”	3139	0,69
Pilica	51°51’44”	21°16’49”	2588	0,69
Przemsza	50°03’58”	19°13’59”	2474	0,69
Kwisa	51°34’30”	15°23’41”	1853	0,69
Wisłoka	50°26’17”	21°23’06”	1833	0,69
Bóbr	52°03’05”	15°04’18”	1780	0,69
Liswarta	51°02’50”	19°02’09”	1375	0,69
Wda	53°24’42”	18°28’45”	1345	0,7
Drawa	52°51’29”	15°59’28”	1335	0,7
Jeziorka	51°13’06”	16°33’26”	1264	0,66
Mienia	52°08’39”	21°16’22”	1224	0,66
Marycha	53°57’22”	23°30’53”	1193	0,71
Rospuda	53°53’00”	22°58’08”	1154	0,67
Sztoła	50°16’01”	19°21’13”	1122	0,67
Cybina	52°25’28”	16°57’11”	1073	0,69
Krutynia	53°44’05”	21°33’04”	1069	0,72
Omulew	53°04’34”	21°33’04”	1064	0,7
Brynica	50°15’32”	19°08’14”	1007	0,7
Czarna Woda	51°01’13”	16°46’47”	1002	0,74
San	50°44’15”	21°50’43”	1000	0,69

Note: the full list of the rivers is available as an appendix.

Temporal modelling

The photos have the innate date and time, therefor it is possible to capture the seasonality of activities proximate to the rivers, or identification of daily, weekly, or monthly patterns by comparing the time elapsed from earliest and latest photos (if any). The number of unique visitors and average time spent at each zone are also demonstrable with maps or graphs. This process uses the same method as the spatial clustering, however, with temporal data.

The results are provided in Figures 3 to 5. As such, Figure 3 reveals the raising trend to visit the natural settings during the COVID-19 pandemic, therefore, the most visits have been occurred during mid 2020 and continued in 2021.

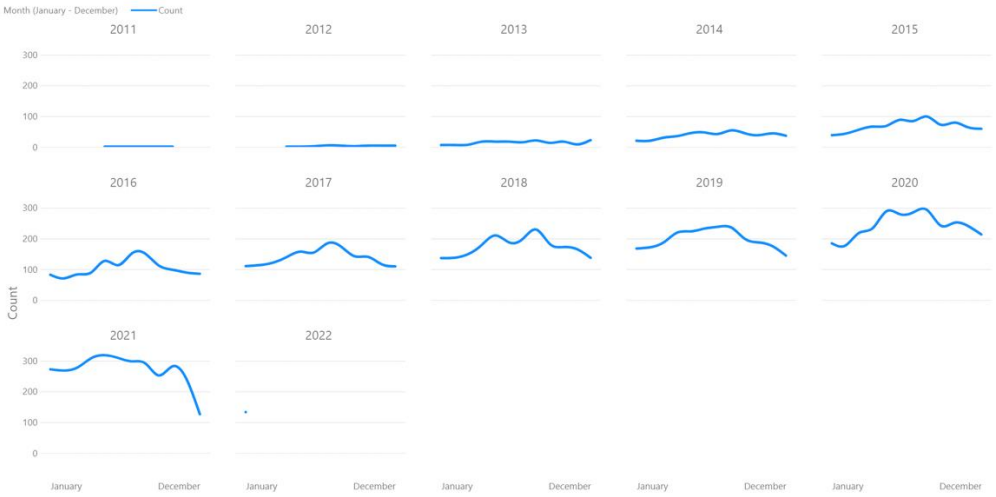

Figure 3. The yearly visits based on month.

Figure 4 reveals the average busiest days of the month with first week of January and mid-August from the years 2011-2022 soaring in numbers. Also, figure 5 reveals which hour most of the visits occurred with evenings being popular amongst the visitors specifically Sunday evenings.

Figure 4. Average monthly visits based on days between 2011-2022

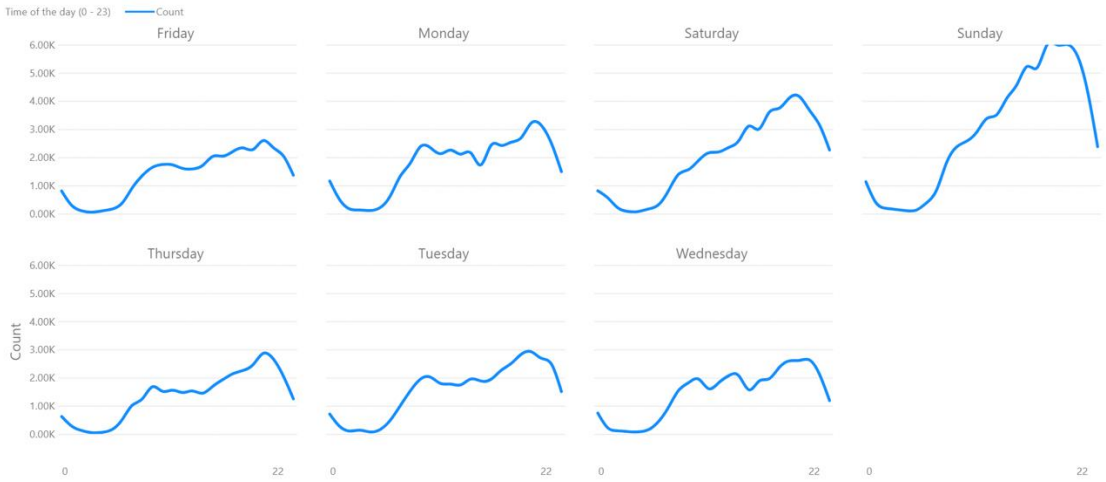

Figure 5. Average weekly visits based on hours between 2011-2022

Rivers and the Covid-19 pandemic

We further analysed the data to find out a pattern of visitation during and before Covid-19 pandemic in relationship to visitors' sentiments. After deletion of the missing data (<5%), we employed an independent Sample T-Test using Welch's T technique. As shown in table 3, There

has been a significant and negative difference (P<.001, ß= -20.7) in visitors' sentiment before and after the pandemic. In line with the study of Helliwell et al. (2021), our result show visitors where generally happier before the Covid-19 pandemic.

Table 3. Independent Samples T-Test

		Statistic	df	p
Score sentiment	Welch's t	-20.7	233834	< .001

Group Descriptives						
	Group	**N**	**Mean**	**Median**	**SD**	**SE**
Score sentiment	During Covid	164850	0.692	0.670	0.136	3.36
	Before Covid	116562	0.703	0.690	0.152	4.44

Further excavation of data provides more in-depth insight into sentiment scores and pandemic related relationships. We applied linear regression analysis of obtained Instagram data with the country data on Covid-19 cases reported provided by World Health Organization (WHO). As revealed in Table 4 and Figure 6, while there were more visits during the Covid-19 pandemic in general, there has been less visits during the peak days of Covid-19 (P<.000, ß= -0.006). It may reveal that visitors have used the time during wavelength to relax next to the rivers. These results may need to be further confirmed by the Public Health and Social Measures (PHSM) taken into the place on those periods to conclude whether the restrictions were the cause or other factors played a role in the visiting pattern.

Table 4. Correlation between Number of visits and Covid-19 cases.

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	269.539	6.877		39.195	.000
	Covid Cases	-.006	.001	-.294	-8.351	.000
Dependent Variable: Number of Visits						

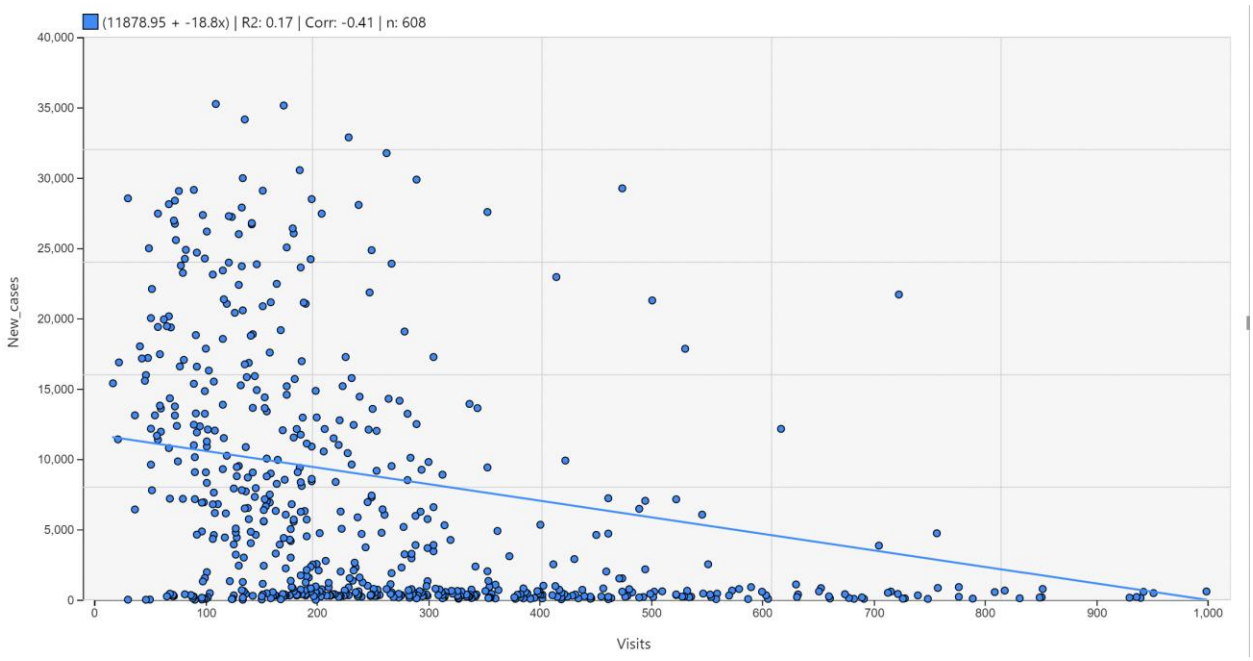

Figure 6. Linear Regression on new Covid-19 cases and number of visits.

However, as seen in Table 5 and Figure 7, there is a negative and significant relationship between number of Covid-19 cases and the Sentiment score of the visitors. This reveals that during Covid-19 peak days the sentiment score of the visitors were lower compared to the days with lower number of Covid-19 cases. The discussion and conclusion are provided below.

Table 5. Correlation between Covid-19 cases and visitors' sentiments

Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.
		B	Std. Error	Beta		
1	(Constant)	24886.276	5091.517		4.888	.000
	Sentiment	-20688.264	5660.542	-.140	-3.655	.000
Dependent Variable: Covid Cases						

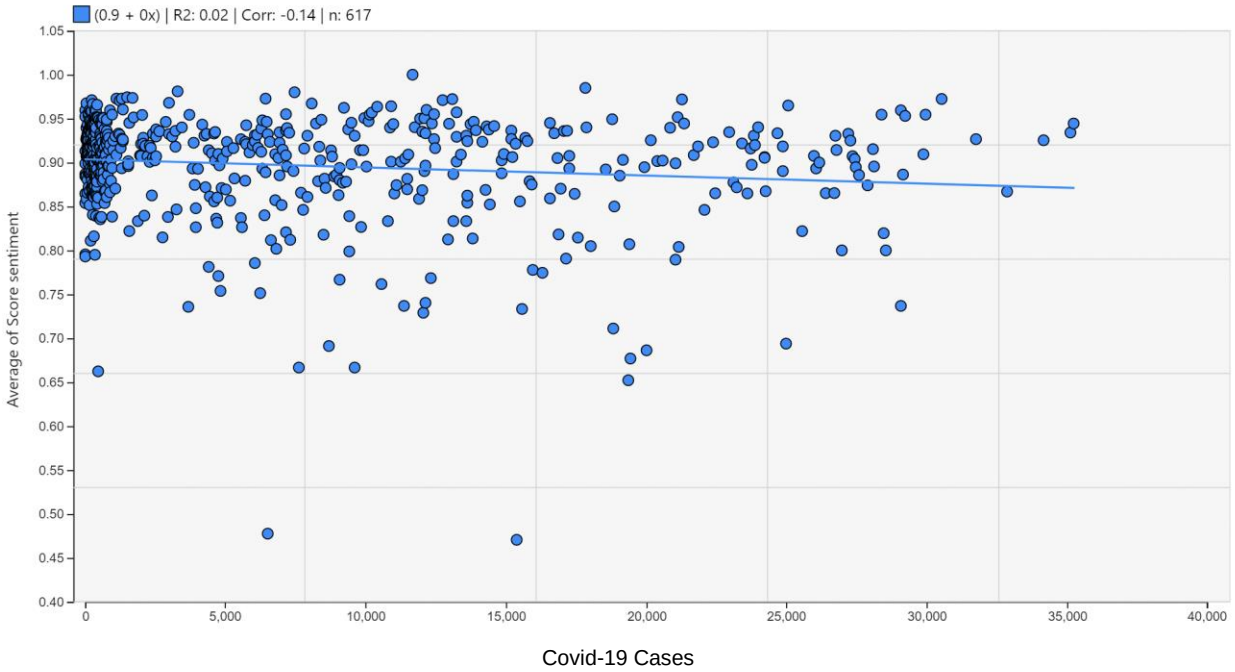

Figure 7. Linear Regression on new Covid-19 cases and visitors' sentiments.

Conclusion and Discussion

Communities living near rivers, as well as nature lovers who use these ever-increasing popular sites for various leisure activities such as fishing, birdwatching, swimming, and other activities are highly influenced by radical changes such as pandemic or climatic changes. Our study aims to find patterns on how many and where people engage in activities near rivers based on their mood and sentiments linked to those experiences. Unveiling these patterns around the river provide unique insight into how these areas may be effectively managed specifically during the pandemic where an ever-increasing number of people benefited from river ecosystem services such as mental health and well-being. Our study successfully categorized rivers based on the volume of visit and the sentiment via the metatags associated with Instagram photos. This outcome is consistent with Jenkins' (2003) prior research, who suggest the use of generated photographs may be useful for DMOs.

As such, the finding provide insight firstly into the visitors' language preferences when posting photos with hashtags and time of visits per year, month, day, or even hour. Secondly, visitors are posing more pressure on the rivers. This has been especially visible in enormous number of posts during Covid-19; this could be interpreted for further managerial (de)marketing strategies for the sites. As seen in the results, a pressure on the natural settings could be alleviated or shifted in times or places with strategies that promote other options for visitors. Although visitors demonstrate a version of themselves through their personal experiences, the results could further be inform experience designers.

Thirdly, while in general visitors put more pressure to the nature; These sites could be used to convey positive moods and sentiment during visits. This interpretation, however, begets further research to compare the moods before and after visitation. By correlating the number of new Covid -19 case record and number of visits, we assume that while the lockdown measurement was in place, people were able to benefit from the rivers to enhance their sentiment and mood, specifically when their mood were at the lowest point. In this interpretation, rivers have arguably become a remedy to overcoming Covid-19 related stress and mood decline.

This study is a steppingstone to offer a main practical implication for DMOs. This is consistent with Onofrei et al. (2022) and Font's (1997) results about the use of social media to establish and promote benefits from visiting destinations to behaviourally engage specific visitors for specific locations.

Limitations

Social media, assisting in the articulation of patterns and behaviours proximate to the river, provides unprecedented insight to better macro management of the area. The research builds on thematic narratives and metadata of photos posted on social media along with the application of machine learning methods to the existing norm for extraction to generate empirical patterns that link practices to the management of river. However, there are limitations such as biased data (Access only to the public pages), over representation of youth age group, and the contrarian cases in the dataset that needs to be addressed through extensive exploratory research based on pen and paper in tandem with the goals of this study.

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