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Do Online Comments Affect Environmental Management? Identifying Factors Related to Environmental Management and Sustainability of Hotels

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Abstract: The main aim of this study was to identify the key indicators related to environmental management and sustainability of hotels as perceived by travelers during their trips. The methodology used was a sentiment analysis with an algorithm developed in Python trained with data mining and machine learning, with the MonkeyLearn library in the hotel industry sector under the eWOM model (e-Word of Mouth). The results with negative, positive and neutral feelings were submitted to a textual analysis with the qualitative analysis software Nvivo Pro 12. The sample consisted of the 25 best hotels in Switzerland according to Traveler's Choice from TripAdvisor ranking 2018 that draws from more than 500,000 reviews. For data extraction, we connected to the TripAdvisor API, obtaining a sample of $n = 8331$ reviews of the hotels that made up the ranking. The results of the study highlight the key factors related to environmental management detected by travelers during their stay in hotels and can be meaningfully used by managers or hotel managers to improve their services and enhance the value provided by their policies of sustainability and respect for the environment. The limitations of the present study relate to the size of the sample and the number of hotels included in the present analysis.

Keywords: environmental factors; sentiment analysis; e-WOM; environmental management; sentiment analysis; textual analysis; sustainability; machine learning

1. Introduction

Generating 10% of global GDP (Gross Domestic Product), tourism is the third largest industry in the world. Tourism is also a key factor for economic growth, since, in 2015, international tourism generated 1.5 trillion USD. Finally, tourism is essential in the creation of employment and sustainability around the world, as one in every eleven jobs is in tourism [1].

Since the 1980s, the evolution of technology and communications has led to a dramatic evolution of the tourism industry, allowing the different actors involved in tourism services to interact globally, thus improving their operational and management practices [1,2]. Accordingly, both tourist destinations and those responsible for the sustainability of hotel management have improved their competitiveness and decision-making.

The development of communication and information technologies has also allowed consumers to more easily access the information they use to plan their trips, and better interact with tourism service providers [2]. This new technological ecosystem where consumers are increasingly informed embodies

a paradigm shift where users not only look for products or services but also expect these products and services to be aligned with their vision of the world and their values of social and environmental justice; moreover, users do not hesitate to share their opinions with other users through online channels [3,4].

In this context, it should be noted that tourism is, in essence, an experiential and transformative industry that not only serves to reinforce the beliefs of tourists but also has the power to transform society, favoring environmental awareness and fostering sustainable practices among individuals who are not less familiar with those practices.

As a result, staff members responsible for hotel establishments' management have to be aware of the opinions that tourists have of their establishment, as well as of the fact that tourists have every possibility to freely express their opinions using new channels. Such awareness is necessary to improve the competitiveness of hotel establishments through these new information channels, as well as to show their responsibility as leaders of a transformative industry capable of raising society's awareness of environmental management and sustainability.

In this respect, almost two decades ago, Gössling [5] was the first to emphasize the growing number of international tourists and the consequences that these displacements could have on the environment and long-term sustainability. In his work, Gössling [5] focused on the following five main aspects: (1) the change in coverage and land use; (2) energy consumption; (3) possible extinction of wild species; (4) spread of diseases; and (5) understanding of the impact of tourism on the environment. Other pioneer works that sought to improve the understanding of the impact that tourism had on the environment include the studies by Saarinen and Jarkko [6] and Hunter [7]. Later, some authors demonstrated that the tourism sector is too slow to implement policies that take care of the environment [8] and argued that the main aim of many establishments in this industry was not to protect the environment, but to improve their competitive position in the market [9].

However, in their analysis of a random sample of 291 tourism and non-tourism companies in Australia, Moyle et al. [10] concluded that tourism companies are more committed to sustainable environmental practices and demonstrate that tourism companies are not slower when adopting sustainable practices than companies in other industries. In this context, a legitimate question that arises is as follows: What are the factors that consumers in the tourism industry value the most in terms of sustainable practices, and how do these factors influence their decisions about the destinations they decide to visit?

1.1. Tourism Trends and Environmental Management

According to the data obtained by the World Tourism Organization (UNWTO), in 2017, there was a 7% increase in the arrival of international tourists as compared to the previous year, reaching 1322 million tourists. In addition, as shown in Table 1, it is expected that this growth tendency will persist in 2018 and, according to experts, it should not be less than 4–5%, since Table 1 shows the annual increase with respect to previous years around the world. In an increasingly global tourism and international trade, the growth trends of tourism and environmental management are important data to be considered. At the same time, considering this strong increase in the reception of international tourists, it is necessary to consider the interests of members of the local communities, ensuring that the latter can benefit from this increase in visitors and align this growth of international tourism with the Sustainable Development Goals. These sustainable development objectives are intended to be a quantitative measure for governments to explain their performance in terms of a series of challenges, ranging from pollution control to natural resource management.

In this relation, it is important to highlight that 2017 was the International Year of Sustainable Tourism, and some of the challenges that arose from the World Tourism Organization of the United Nations (UNWTO) were precisely the efficiency in the management of resources, protection of the environment, and fight against climate change.

Table 1. International Tourist Arrivals by (sub) region.

	Full Year		Change				
	2015	2016	2017	2017	16/15	17/16	18
			(million)	(%)		(%)	YTD
World *	1.195	1.239	1.323	100	3.7	6.8	6.2
Advanced economies	655	685	725	54.8	4.7	5.8	5.3
Emerging economies	540	554	597	45.2	2.5	7.9	7.1
<i>By UNWTO Regions</i>							
Europe	605.1	619.0	671.1	50.7	2.3	8.4	6.8
Northern Europe	69.8	73.8	77.3	5.8	5.8	4.8	1.4
Western Europe	181.5	181.5	194.6	14.7	0.0	7.2	7.8
Central Eastern Eur.	122.4	126.7	133.0	10.1	3.5	4.9	6.3
Southern Medit. Eur.	231.4	237.1	266.2	20.1	2.4	12.3	8.0
-of which EU-28	478.6	499.8	538.1	40.7	4.4	7.7	5.6
Asia and the Pacific	284.1	305.9	323.2	24.4	7.7	5.6	7.8
North-East Asia	142.1	154.3	159.5	12.1	8.6	3.4	6.3
South-East Asia	104.2	110.8	120.4	9.1	6.3	8.6	10.0
Oceania	14.3	15.7	16.6	1.3	9.7	6.0	5.2
South Asia	23.5	25.1	26.7	2.0	7.0	6.1	8.8
Americas	193.7	200.7	207.3	15.7	3.6	3.3	3.0
North America	127.5	130.9	133.3	10.1	2.7	1.8	4.1
Caribbean	24.1	25.2	26.1	2.0	4.7	3.4	−9.5
Central America	10.2	10.7	11.2	0.8	4.1	4.7	5.7
South America	31.9	33.9	36.7	2.8	6.3	8.4	7.7
Africa	53.6	57.8	63.0	4.8	7.9	9.0	5.6
North Africa	18.0	18.9	21.7	1.6	5.0	14.7	4.4
Sub-Saharan Africa	35.6	38.9	41.3	3.1	9.3	6.2	6.1
Middle East	581	55.6	58.2	4.4	−4.3	4.6	4.5

* Classification based on the International Monetary Fund (IMF). World Economic Outlook, June 2018. Source: World Tourism Organization (UNWTO).

Following this line of work, the tourism sector has proposed reducing its CO₂ emissions by 5%. This has been planned to be achieved by increasing funds for the conservation of heritage, wildlife, and the environment, and recovering biodiversity through tourism and managing, in a sustainable manner, more than 1800 million international tourists expected for 2030. This growth in the number of tourists is shown in Table 2.

Table 2. International Tourist Arrivals received (million) by UNWTO.

	International Tourist Arrivals Received (million)							
	Actual Data						Projections	
	1980	1990	1995	2000	2005	2010	2020	2030
World *	277	435	528	674	797	940	1.360	1.809
Advanced economies	194	296	334	417	453	498	643	772
Emerging economies	83	139	193	257	345	442	717	1.037
<i>By UNWTO regions</i>								
Africa	7.2	14.8	18.9	26.5	35.4	50.3	85	134
Americas	62.3	92.8	109.0	128.2	133.3	149.7	199	248
Asia and the Pacific	22.8	55.8	82.0	110.1	153.6	204.0	355	535
Europe	177.3	261.5	304.1	385.1	438.7	475.3	620	744
Middle East	7.1	9.6	13.7	24.1	36.3	60.9	101	149

* Classification based on the International Monetary Fund (IMF). World Economic Outlook, June 2018. Source: World Tourism Organization (UNWTO).

1.2. Hotel Tourism in Switzerland

Owing to its natural wealth, an image of a politically and economically safe destination, well-trained hotel and tourism industry staff, well-developed hotel infrastructure and good transportation, Switzerland is a popular tourist destination.

The sustainable factors of tourism in Switzerland are an interesting research object because one of the country's strengths is precisely the natural mountain wealth so that the impact that tourism can have on environmental factors might be negative. These include climate change or the disappearance of mountain ecosystems. It is for this reason that it is necessary to identify concrete actions that would allow stopping this environmental impact in time to minimize the negative economic consequences in Switzerland [3].

There is considerable previous work on Switzerland as a tourist destination, largely due to the popularity of this country among tourists that arises from the richness of its landscapes and the ways of conserving them, while taking advantage of them as tourist resources [11]. This body of work highlights Switzerland as a popular tourist destination with significant natural resources, ranging from lakes to mountains or forests, which are combined with cultural and historical resources [12,13].

Tourism is the fourth export industry in Switzerland. In 2015, with 16,000 million Swiss francs, its contribution to the Gross Domestic Product (GDP) amounted to 2.6% and generated a demand of 45,000 Swiss francs. The hotel industry alone generates an annual turnover of 7.6 billion Swiss francs and currently employs more than 63,000 full-time employees. In addition, Switzerland is a country of sustainable tourism where natural resources are a good that must be protected.

Among the country's strengths are tourist attractions such as landscapes, lakes, or historic cities that need to be protected, since they are part of the image that international tourists have in the country. To this end, the Federal Office for the Environment (FOEN), a body in charge of creating policies that ensure the protection of the natural and cultural wealth of the country while favoring its economic use, has been established.

Table 3 shows the estimate of the economic growth that tourism will produce in Switzerland until 2027. From the economic point of view, one of the most important points is the contribution of tourism to the GDP of the country. This figure includes all economic activities directly or indirectly related to tourism activities. It is expected that, in 2027, the total contribution of tourism in Switzerland will be 10.1%, i.e., 76.4 billion Swiss francs (77.77 billion dollars).

Table 3. Growth estimation and forecast for Switzerland (WTTC).

Switzerland (Growth) (%)	2016 USD bn	2016 % of Total	2017 Growth	USD bn	2027 % of Total	Growth
Direct contribution to GDP	15.7	2.4	3.9	21.0	2.7	2.6
Total contribution to GDP	60.1	9.1	3.4	77.7	10.1	2.3
Direct contribution to employment (thousand)	165	3.3	4.6	236	4.4	3.2
Total Contribution to employment	598	11.8	4.0	813	15.3	2.7
Visitor exports	18.6	5.4	8.2	32.5	6.5	4.9
Domestic spending	27.9	4.2	1.4	30.6	4.0	0.8
Leisure spending	39.4	2.0	2.4	51.7	2.2	2.5
Business spending	7.1	0.4	13.8	11.4	0.5	3.5
Capital investment	2.8	1.7	2.5	3.6	1.8	2.2

In addition, for 2017, 9,725,000 arrivals of international tourists were expected—a figure that will continue to grow during the following years until 2027, reaching by that year a total of 12,795,000 arrivals. The dramatic growth of tourist arrivals will also lead to the growth of tourist employment figures. While, in 2017, there were 622,000 tourist workers, i.e., 12.2% of total employment in the

country, by 2027, this figure is expected to reach 813,000 jobs, i.e., 15.3% of total employment in the country.

While this economic development is important, it cannot be studied in isolation, since one of the most important aspects of the country is its natural wealth and environmental sustainability. In this respect, it is necessary to highlight that there are several awards related to the development of sustainable tourism that Switzerland has won in recent years. Among them is the first position in the Environmental Development Index (EPI) in 2018. This index classifies 180 countries into 24 performance indicators covering environmental health and vitality of the ecosystem. With 20 years of experience, the EPI reveals a tension between two fundamental dimensions of sustainable development: (1) environmental health, which increases with economic growth and prosperity; and (2) ecosystem vitality, which undergoes industrialization and urbanization. Good governance emerges as the critical factor required to balance these different dimensions of sustainability.

As discussed above, the development of the tourism industry has a strong impact on the environment. Aiming to identify the key indicators that affect this industry due to its own evolution, we improved the indicators proposed by Saura et al. [3] and Moyle et al. [10] with the factors derived from a review carried out by Perrat [13]. The resulting factors are summarized in Table 4.

Table 4. Factors of the development of tourism in the environment.

Sustainable	Non-Sustainable
General Concepts	
Slow development	Rapid development
Controlled development	Uncontrolled development
Appropriate scale	Inappropriate scale
Long-term	Short term
Local control	Remote control
Development Strategies	
Plan, then develop	Develop without planning
Concept-led schemes	Project-led scheme
All five landscapes concerned	Concentrating on “honeypots”
Pressures and benefits diffused	Increase capacity
Local developers	Outside developers
Locals employed	Imported labor
Vernacular architecture	Non-vernacular architecture
Appropriate public flow management	Accumulation of public
Tourist Behavior	
Low value	Little or no mental preparation
Some mental preparation	No learning of local traditions and language
Learning of local traditions and language	Intensive and insensitive use
Sensitive to destinations and hosts	Unlikely to return
Repeat visits	

Therefore, we can conclude that Switzerland is a country that has attracted considerable scholarly attention with regard to sustainability, because the country has a great growth potential and good bases such as hotel infrastructure and services, which, combined with appropriate management of the country’s natural resources, can have a significant impact on the industry.

The main aim of the present study was to identify the key factors or indicators that travelers detect during their trips related to the environment and sustainability. In terms of methodology, we carried out a sentiment analysis with an algorithm developed in Python and trained with data mining and machine learning with the MonkeyLearn Software (San Francisco, CA, USA) in the hotel industry sector under the theoretical model of eWOM (e-Word of Mouth). A textual analysis of the negative, positive, and neutral results was made using the Nvivo Pro 12 software (QSR International, Melbourne, Australia).

The sample consisted of 25 best hotels in Switzerland according to the Ranking Traveler's Choice from TripAdvisor 2018. The sample comprised 8331 reviews obtained on TripAdvisor by the hotels that made up this ranking and that were downloaded after connecting to the API. TripAdvisor [3].

The results of the present study highlight the key factors related to the environment detected by travelers during their stay in hotels and can be meaningfully used by managers or hotel managers to improve their services and to enhance the value of their policies aimed at sustainability and respect for the environment.

2. Literature Review

In the last decade, although sustainability in tourism has been a widely researched topic, little attention has been paid to the factors that favor sustainable management from the point of view of tourists [1,10,13].

Previous studies have predominantly focused on sustainability and its importance for the tourism sector; however, there is still a gap in the literature regarding the factors that determine sustainability in tourism and enhance the awareness about the sustainability of those responsible for hotel establishments so that to ensure its more effective implementation.

Studies by Moyle et al. [10], Butler [8] and Sharples [14] used questionnaires to obtain information about the establishments and thus to assess whether the management is sustainable. Currently, research is being published that, supported by technological advances in tourism, identifies the opinions of tourists to extract the most important factors in the sustainability of the tourism sector management. This research takes advantage of the new technologies to detect new avenues of improvement and active listening on the Internet and social networks [15,16].

Previous research has given rise to a new theoretical model known as e-WOM (Electronic Word of Mouth), in which traditional communication has undergone changes with the development of the Internet [17]. The unstoppable advance of technology [18–21] and the expansion of the Internet have caused the traditional communication to transform into online communication. The electronic communication can be defined as “personal communication supported by the Internet and can be disseminated by a multitude of online applications such as online forums, electronic billboard systems, blogs, review sites, and social networks” [22].

Currently, e-WOM plays an important role in the communication of any company and the success of the products and services that are marketed is no longer determined by traditional advertising, but rather depends on reviews and online comments written by consumers themselves [23]. In this area, some studies are available that explore the differences in online behaviors of users from Asian or European countries [24,25]. Other studies in this domain focus on a single segment, e.g., young people, to get a deep understanding of their behavior in social networks, such as Facebook, that has dramatically changed the way such population groups establish social relationships [26].

With respect to the research focus of the present study, several authors, such as Papathanassis [4] or Saura et al. [3], argued that online recommendations are particularly important for the tourism sector and should be taken into account by those responsible for hotel management. In one pertinent study, Londoño and Hernandez-Maskivker [27] applied sentiment analysis to analyze online reviews on TripAdvisor to identify environmental factors of the analyzed hotels. Likewise, Phillips et al. [28] used sentiment analysis to analyze online reviews of Swiss hotels obtained from 69 different sources to extract indicators of environmental management. Table 5 provides a summary of the main studies relevant to the present research.

Table 5. Major previous studies on sustainable development in the tourism industry.

References	Summary
[3]	Identified the key factors related to the environment for the management of sustainable hotels, conducting sentiment and textual analyses on the reviews of hotel users on Twitter. The authors used an algorithm based on machine learning and connect to the Twitter API to perform data extraction.
[27]	Identified practices related to environmental sustainability using sentiment analysis of TripAdvisor's comments
[28]	Examined the determinants of Swiss hotel performance using an artificial neural network model that builds based on previous e-WOM studies of 59,688 online comments obtained from 69 different sources. This allowed the authors to identify those indicators, including the environmental ones, which improve the management of hotels in Switzerland.
[16]	Applied the latest advances in language processing techniques (NLP) and machine learning to develop an algorithm making it possible to classify written user reviews on TripAdvisor into positive or negative ones according to the word used in the reviews
[15]	Presented a model that allows organizing and accessing online reviews of hotels. The authors emphasized that the opinions and comments made by users on hotel web pages are an important source of information when planning trips and knowing those comments is necessary for both quality control and for the sustainability of the management of the hotels.
[4]	Demonstrated that online recommendations, known as e-WOM, are especially important for the tourism sector and need to be considered by those responsible for the management of hotels.

3. Related Work on Environment and Sustainability Ecosystems on TripAdvisor

The Internet revolution has not only changed the way in which information is distributed and the way in which consumers have access to it but also how travelers choose and book hotels [29]. According to Buhalis and Law [30], 70% of users who made travel reservations during 2008 used the online channel to do so.

Among all possible online channels and platforms, many pertinent studies have highlighted the growing importance of TripAdvisor [31–33].

TripAdvisor is an American travel website founded in February 2000 [34]. This online platform allows users to share their travel experiences based on the principle that travelers can post reviews, comments, and ratings about a destination, hotel, or attraction and can add photos, videos, travel maps of their trips or participate in discussion forums [35].

TripAdvisor users can write reviews and assign scores from 1 (“terrible”) to 5 (“excellent”) based on a set of criteria that include general satisfaction, quality of sleep, location, rooms, service, value for money, and cleanliness [36]. This online platform has 350 million monthly visitors and contains over 300 million comments and opinions from real travelers, covering more than 6.2 million accommodations, restaurants, and attractions [37]. Of relevance for the present research, Londoño and Hernandez-Maskivker [27] applied sentiment analysis to the TripAdvisor comments on the sustainability of the hotels included in the TripAdvisor Green Leaders program to identify practices related to environmental sustainability.

3.1. Sentiment Analysis

There are a growing number of studies that use sentiment analysis to identify the opinions in the messages under analysis. These findings are usually based on models developed based on machine learning that is applied to the opinions that users write in social networks on a specific topic [38,39].

For instance, Phillips et al. [28] developed artificial neural networks to determine the Swiss hotel performance and thus identified those environmental factors that allow for improving the management of hotels in this country. To this end, the authors extracted 59,688 online comments from 69 different sources and performed sentiment analysis to extract the environmental factors that were most present

in the comments shared by the users. Sentiment analysis can be combined with other technologies to extract the most important factors under consideration [3].

Furthermore, Pak and Paroubek [40] developed different methodologies to analyze Twitter comments. In general, the appearance of certain words is frequently the main object of analysis. When specific words occur recurrently, they give rise to a positive or negative feeling, thus demonstrating that sentiment analysis can be meaningfully applied to communication on social networks. In this relation, Londoño and Hernandez-Maskivker [27] applied sentiment analysis to comments on TripAdvisor, demonstrating that this social network is a suitable platform for this approach.

3.2. Textual Analysis

Textual analysis is a qualitative analysis procedure in which various factors related to an event, a company, or any other object of study are grouped into nodes [41]. The most common way to perform a textual analysis of selected terms is through the use of Nvivo software. The main purpose of the textual analysis is to obtain an exploratory analysis based on raw data, obtaining results of a higher descriptive quality than would be possible without such software [42].

The obtained results are the first categorization at a higher level where the nodes are conceptually independent of each other. At the second level, branches appear that leave each of the nodes and are organized hierarchically. Finally, as mentioned above, a series of indicators are obtained that reflect each of the categories related to the object of study [43,44].

In one study illustrating this approach, Saura et al. [3] performed a classification of environmental factors into three categories or nodes. The first node (N_1) included negative factors, the second node (N_2) neutral factors, and the third node (N_3) positive factors.

4. Conceptual Framework and Hypothesis Development

As discussed in Section 2, e-WOM is “personal communication supported by the Internet and can be disseminated by a multitude of online applications such as online forums, electronic billboard systems, blogs, review sites, and social networks” [22,45,46]. According to several authors, including Papathanassis and Knolle [4] and Saura, et al. [3], online recommendations are particularly important for the tourism sector and need to be taken in account by those responsible for managing the hotels [47–49]. Likewise, Anderson [31] and Kasper and Vela [15] also explained the importance of TripAdvisor for the tourism sector and how travelers write reviews on various topics related to their stay, including the environmental environment. Finally, Phillips et al. [28] analyzed the comments of Swiss tourists who stayed in hotels and that contained indicators that can improve the management of hotels [50–53]. Based on the literature review, the following hypothesis is put forward:

Hypothesis H1. *Online reviews of travelers during their stay in Swiss hotels would contain indicators related to the management of environmental issues by these hotels.*

Furthermore, Londoño and Hernandez-Maskivker [27] applied sentiment analysis to TripAdvisor comments to identify practices related to environmental sustainability [54–56]. On the other hand, García et al. (2012) [16] used a questionnaire to obtain information on the most important indicators that improve the management of environmental aspects by hotels [57–60]. Based on previous research, the following hypothesis can be formulated:

Hypothesis H2. *The feeling of the reviews (positive, negative, and neutral) of travelers during their stay in Swiss hotels would contain indicators (positive, negative, and neutral) for the management of environmental issues by these hotels.*

Using the Tourist Happiness Index, Chen and Li [44] analyzed the positive feeling of the tourists who stayed in Swiss hotels of environmental tourism. Furthermore, Abou-Zeid et al. [61] concluded

that the feeling of Swiss tourists is positive when analyzing environmental factors related to transport. Next, Phillips et al. [28] analyzed a sample of 235 Swiss hotels for the period of 2008–2010 and obtained 59,688 positive comments from 69 online sources [62–65]. Based on the results of the studies mentioned above, we propose the following hypothesis:

Hypothesis H3. *The sentiment of travelers on the indicators of management of environmental issues by Swiss hotels would be positive.*

5. Methodology

The methodology used in this study was, in the first place, sentiment analysis of traveler reviews on the TripAdvisor platform that works with processes of machine learning and that was trained with an algorithm developed in Python connected to the Monkeylearn library (MonkeyLearn, San Francisco, CA, USA) based on the research of Londoño and Hernandez-Maskivker [3,10,27,66–68]. Subsequently, textual analysis of the negative, neutral, and positive reviews was conducted using the qualitative analysis software Nvivo Pro 12 [10,69,70], which identifies key factors for the management of environmental issues by Swiss hotels using the presented process as a methodological support in the research conducted by Saura et al. [3,49,71,72].

5.1. Sample

The main objective of the present study was to identify the key factors related to the management of environmental issues by Swiss hotels, taking into account the feelings of travelers' reviews during their hotel stay [73–75]. The sample was made up of the best 25 hotels in Switzerland according to the ranking of TripAdvisor Traveler's Choice Awards, which was drawn from more than 500 million opinions in Switzerland. The reviews ranged from 1 ("terrible") to 5 ("excellent") and included user evaluation of a set of criteria, such as general satisfaction, quality of sleep, location, rooms, service, value for money, and cleanliness [3,27,28].

To identify the indicated indicators, the data extraction resulted in a total sample of $n = 8331$ reviews extracted from the TripAdvisor API from 19 December 2017 to 15 January 2018, according to the official profiles of Swiss hotels that won the TripAdvisor Traveler's Choice Award [75–77].

Appendix A shows the TripAdvisor identification information of the hotels under study.

5.2. Data Collection and Extraction

The data were collected using the TripAdvisor API between 19 December 2017 and 15 January 2018. The hotel profiles winning TripAdvisor Traveler's Choice Award in Switzerland in 2018 were included in the analysis [78,79].

In terms of Sentiment Analysis, we used the an available algorithm in the MonkeyLearn library that is developed in Python and uses machine learning and data-mining techniques to improve the prediction and significance levels of the algorithm results [10,80–83]. To this end, we first connected to the algorithm and trained it with data-mining processes using a sample of hotel reviews to increase the significance and predictability of the algorithm to >0.650 , which is an indicator that measures the average of the success of a machine when using machine learning techniques [10,64,80]. As a result of the application of the sentiment analysis algorithm, the reviews were divided into positive, neutral, and negative, and were subdivided into different databases. In the next step, we applied textual analysis to the results [3,27,28]. The reviews of TripAdvisor have been studied under approximations with Sentiment Analysis [27,37]. Although the reviews in TripAdvisor are usually long and can mix both negative and positive feelings, we trained through data mining the algorithm that applies the sentiment analysis so that it can correctly detect the feeling that predominates in the review even if both positive and negative factors are simultaneously indexed, exclusively with TripAdvisor hotel reviews. The feeling of global interpretation in a review is above indicators that can be made by mixing

feelings indiscriminately throughout the review [3] so that data mining allows us to find the feeling with the significance and predictability indicated above.

As already indicated, the reviews were divided into positive, neutral, and negative. Textual Analysis was performed on these three groups of reviews using the qualitative analysis software Nvivo Pro 12 (QSR International, Melbourne, Australia) [46]. Then, the databases were subdivided into nodes (N) corresponding to review types N_1 (positive), N_2 (neutral), and N_3 (negative). The nodes were configured as containers for the information which included the evidence and had already been grouped beforehand. Of note, the creation, design, and exploration of nodes is a way to research pure data to achieve higher-quality descriptive and explanatory levels than could otherwise be reached without it [3,17,19].

When this process was carried out, Nvivo Pro 12 showed the indicators of Count, to indicate the times that an indicator was repeated; similar factors, which were groupings of data similar to those indicated in the nodes; and weighted percentage, which was the weight of the nodes in terms of the total data in the database [81,82]. To calculate the weighted percentage, we used Nvivo Pro 12 with the following formula [46] (see Equation (1)):

$$K = \sum k_i/n; \quad i = \{1, \dots, n\} \quad n = (1, 25) \quad (1)$$

In the formula, K is found using a query that allows the software to search the text. The constant varies for each word, and also for the same word in each review under study. The behavior of each of the words and for each review can be seen. Thus, a K value is found for each hotel, which is later compared with that of the other hotels. In this way, the average K for all the reviews is calculated to obtain the global value [82].

In this way, we can group in nodes each of the indicators found by the development of the methodological process and specific textual analysis. These indicators are grouped into categories that form a node, and these nodes are linked to the feeling indicated by the positive, negative or neutral reviews database, from which we rely on for textual analysis. Hence, we can finally group all indicators identified according to sentiment and based on the results of the application of Nvivo Pro 12 with the indicated formula and the weight of the category of the node that makes up the indicators [3,27,46]

6. Results

To identify the factors of environmental management observed by travelers during their stay in the hotels, an automatic classification was developed with machine learning after the extraction of data (see Figure 1), which resulted in the division of travelers' reviews into positive, neutral, and negative.

The total number of analyzed TripAdvisor reviews was $n = 8331$. The average for hotel reviews examined was 333.24.

From the machine learning sentiment analysis, the greatest probability percentage of success was 0.985, while the lowest was 0.762. The probability percentage is a measure of accuracy and recall of the samples in each category. This percentage is the result of success in the classification achieved by the Support Vector Machine (SVM) algorithm that works with machine learning and which we have trained with data mining to perform the sentiment analysis. This percentage defines the total average success of the algorithm in the reviews' classification.

Likewise, it must be mentioned that we have used an algorithm based on SVM typology machine learning. The supervised learning is the most popular category of Machine Learning algorithms [27,83]. The disadvantage of using this approach is that, for every training example, we have to provide the correct output until the algorithm acquires a correct percentage of success. The SVM algorithms are a non-probabilistic model which uses a representation of text examples as points in a multidimensional space. These examples are mapped so that the examples of the different categories (sentiments) belong to distinct regions of that space. Then, new texts are mapped onto that same space and predicted to belong to a category based on which region they fall into [83].

In this way, we must point out that the probability percentages resulting from the sentiment analysis for each classification are shown in Figure 1.

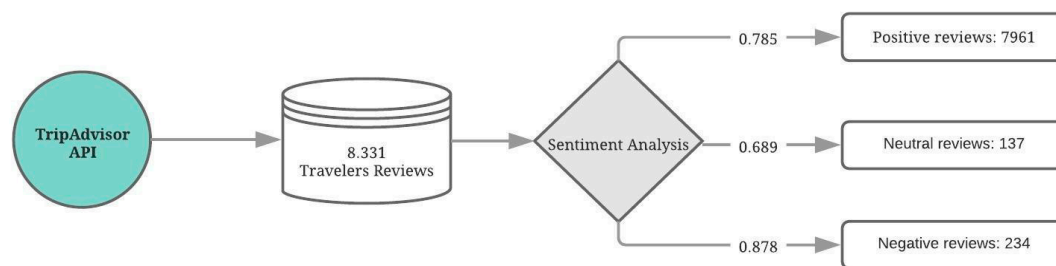


Figure 1. Classification of TripAdvisor Reviews according to user feelings about the environment.

Table 6 shows the probability coefficients obtained by each hotel based on the results of sentiment analysis. In addition, in terms of distribution, there were 7961 positive reviews, 137 neutral reviews, and 234 negative reviews.

Table 6. Comments data that were analyzed and average classification of machine learning probability percentages for each Hotel.

Traveler's Choice from TripAdvisor 2017	N° Reviews	Positive	Neutral	Negative	Average Probability
The Omnia	307	290	3	14	0.809
Cervo Zermatt	439	389	10	40	0.711
The Alpina Gstaad	250	213	4	33	0.641
Matterhorn Focus-Design Hotel	461	435	17	9	0.812
Park Hotel Vitznau	433	423	2	8	0.730
Art Hotel Riposo	375	365	5	5	0.829
Beausite Park Hotel	380	371	1	8	0.805
Le Grand Bellevue	487	483	3	1	0.850
Castello del Sole Beach Resort	276	269	4	3	0.893
Europe Hotel & Spa	149	145	4	-	0.677
Romantik Hotel Hornberg	225	201	17	7	0.946
Atlantis by Giardino	282	277	-	5	0.810
Hotel Eiger	317	311	2	4	0.985
Grand Hotel Kronenhof	585	579	5	1	0.714
Widder Hotel	452	439	8	5	0.531
Parkhotel Beaut Site	406	395	11	-	0.850
Lugano Dante Center Swiss Quality	262	230	4	28	0.655
Giardino Ascona	368	355	2	11	0.750
Schlosshotel Life & Style	201	198	2	1	0.891
Waldhotel Davos	117	111	5	1	0.692
Hotel Waldhaus	170	165	-	5	0.614
Hotel Schweizerhof Bern & The Spa	322	308	8	6	0.830
Storchen Zurich	420	400	17	3	0.608
Carlton Hotel St. Moritz	262	233	3	30	0.776
Hotel Belvedere Grindelwald	382	376	-	6	0.654
n = 8331					

The results of sentiment analysis allowed us to identify the factors related to the management of the environment by hotels according to the analysis of each of the sentiment groups. To identify the key factors for managing the environment from the traveler reviews on TripAdvisor, the results of the sentiment analysis were structured into three nodes: reviews N_1 (positive), N_2 (neutral), and N_3 (negative). Once the reviews were classified in their respective nodes, we began to work on structuring and classifying the text of each node. In this sense, the Nvivo Pro 12 tool allows us to perform a textual analysis of each of the words that are most repeated in the database and that is called itinerancy. The total itinerancy of a word that appears in the database is added to the node that corresponds

to each element and that is subsequently categorized according to the indicator that is identified, for example Nature, Rivers, Views or Local traditions [3]. The total weight of its structured words itinerancy is the indicator that shows the Weighted Percentage [27,28,84]. These groups of data allowed us to analyze the factors related to the management of the environment in a positive, neutral and negative way. Figure 2 shows the methodological process and the subdivision of data in nodes using Nvivo Pro 12 [84].

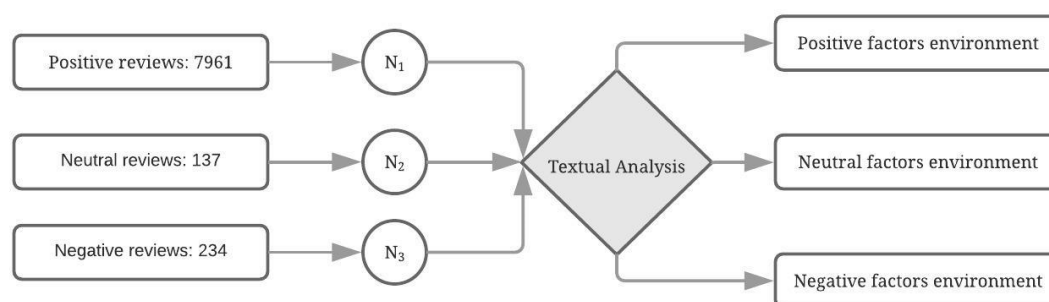


Figure 2. Relationship of nodes and number of traveler reviews for environment factors identification.

Table 7 shows the results of the semantic analysis for environmental management factors in positive hotels indicated by travelers during their stays.

Table 7. Results for N₁ for environment factors identification.

N ₁	Count	Similar Factors	Weighted Percentage
Nature	367	Hotel surroundings, sky, clean air, disconnection, nature noise, flowers, plants, trees, rivers, waterfalls	2.96
Rivers	305	Clean water, hiking, outdoor activities, hiking trails, wild animals, forests	1.98
Views	264	Rooms, no buildings, landscape, sunrise, mountains, sun	0.93
Local traditions	231	No urban areas, local products, traditions, local food, local restaurants	0.77

As can be seen in Table 7, N₁ is composed of four types of indicator categories, namely Nature, Rivers, Views, and Local traditions. The total number of reviews of this type was 1167 with a Weighted Percentage over the total sample of 6.64. Among the factors identified as positive, there were characteristics such as pure air, lack of noise, or the abundance of nature and plants. In addition, in terms of outdoor activities, there were also routes and walks through forests and rivers or wild animals [84,85]. Therefore, the views of nature from the hotel, as well as the mountains and the landscape in general, appear to be positive factors. Local traditions and products of the area were also identified.

In addition, Table 8 shows a selection of positive comments—copied verbatim—as a sample of the extraction of the factors grouped into positive nodes.

In what corresponds to N₂, the categories selected to subdivide the data, as a result of the analysis of the neutral reviews, are those indicators related to the facilities, the air, the local experiences and the excursions. In this case, the total roaming number of this type of indicators is 1376 with an average Weighted Percentage of 3.78 [85]. Although they are not less important due to their condition of neutral factors, they can be considered to maintain the quality standard with respect to the environment by hotels and that have been identified regarding issues such as facilities and their quality and sustainable support, the air of the spaces and the absence of contamination, local experiences in monasteries, churches or old structures of the area, as well as excursions such as hiking, group visits, or other sporting activities to interact with nature [86]. Table 9 shows the indicators identified as a result of textual analysis according to feeling type (positive negative, or neutral).

Table 8. Positive comments regarding N₁ (positive).

TripAdvisor Users	Environment Factors-Positive Reviews
Amanda W.	The location is perfect, only a short distance to both the Zermatt main station and Gornergrat scenic ride train station too. No need to worry about your luggage, they will pick up and drop you back to the station with hotel electric car. The city is pollution free...No cars...just electric ones. Perfect for a holiday getaway from busy city life. Enjoy the fresh oxygen.
Marie-Laure F.	A grand dame of a hotel, reminiscent of true Swiss hospitality offering amazing views of the mountains and country side surrounding the area. Wonderful team and very warm and hospitable owners. A short weekend getaway, an amazing drive up from Milan, and such a breath of oxygen away from our busy lives. A place where time seems to have stopped, a flashback to years gone by, where everything is calm and peaceful, where one can hear the clucking of the cows in the fields and birds singing. A true escape for total relaxation and forgetting all the rest...Would love to come back with the children who would just adore looking at the mountains still covered in snow and for long walks in the forest...Thank you Felix and your team for an amazing stay!
Tamara C.	We were seated on the second floor terrace, which is fringed with flower boxes, and overlooks the river with its swans floating by. Beyond the river, you can see the iconic twin towers of Zurich's historic Grossmünster church and the Altstadt. Second, the service was elegant and professional; nice touch to offer menus in English, including the statements supporting sustainability of raw materials. Finally, the food tasted exquisite and also was beautifully presented.

Table 9. Results for N₂ (neutral) for environment factors identification.

N ₂	Count	Similar Factors	Weighted Percentage
Installations	401	Ancient, unsustainable, digital documents	1.95
Air	394	Pure, large spaces, no pollution	0.74
Local experiences	376	Churches, monasteries, old buildings	0.69
Excursions	205	Hiking, groups of visits, kayaking	0.40

Likewise, Table 10 illustrates reviews categorized as neutral—copied verbatim—for the identification of indicators related to the management of the environment by hotels.

Table 10. Neutral comments concerning N₂ (neutral).

TripAdvisor Users	Environment Factors-Neutral Reviews
Marina 905	The Hotel is the local treasure with its fine cuisine, rich history, friendly staff that make us feel like a special guest, incredible views from each window, wonderful spa area, and great location! The place worth returning! The only thing that made us sad was that we had to leave.
Dooren D.	We stayed only one night but really loved our time there. The welcome was friendly and warm, the staff always helpful and friendly. The rooms were spacious and styled in a regional way. From the balcony we had a lovely view. The wellness area was big enough with 2 saunas and a steam bath. In the lovely garden we found a natural biological pool with refreshing cool water. The garden definitely a place to rest. Our dinner was delicious and the waiters always around. To start the day in a good way have a look at that breakfast. So many things to choose and so many local products. We really enjoyed our time there and will come back.
JalapenoJane	Whenever our family travels to Europe our first stop is in Zurich so we can stay at this hotel. The people of Zurich and especially the people at this hotel make you feel very welcome and they appreciate that you are visiting their city. Everyone at the hotel is eager to answer questions and make suggestions for tourist destinations like where to have the best fondue and where to shop for a good watch or reasonably priced cuckoo clock or weatherhouse. The hotel is very clean the buffet breakfasts are wonderful, delicious and set you off on your day of excursions, in style. This hotel also has a wonderful location if you need to get around to all the most important sites on foot.

Finally, with respect to N_3 , the categories selected to subdivide the data were the main categories of negative indicators that had emerged in textual analysis according to the type sentiment expressed in the analyzed reviews. Of note, these indicators correspond to noise pollution, traditional food, dirt, and sustainable energy. The total number of indicators was 806, with an average of Weighted Percentage of 7.14. With the analysis of N_3 , it is clear that there are certain indicators for the management of the environment that travelers perceived as negative; those were related to noise or crowds of people in natural spaces, the fact that no food is served or food be traditional of the geographical area in which the hotel is located; garbage or fumes that harm and pollute nature, as well as lack of energy efficiency indicators such as solar panels, self-sufficiency zones, or sustainable maintenance policies. Table 11 shows these indicators.

Table 11. Results for N_3 (negative) for environment factors identification.

N_2	Count	Similar Factors	Weighted Percentage
Noise Pollution	278	Noises, music, people agglomeration	2.45
Traditional Food	189	Local products, traditional food	2.37
Dirt	171	Garbage, smoke outlets, restaurants, energy	1.34
Sustainable energy	168	Energy efficiency, empty areas, solar plates, self-efficiency	0.98

Table 12 shows different indicators related to the textual analysis by negative feeling in the reviews made by travelers about Swiss hotels—copied verbatim.

Table 12. Negative comments regarding N_3 (negative).

TripAdvisor Users	Environment Factors-Negative Reviews
Christine H.	The facilities are not the best, there is no gym, just two outdated machines outdoors near the pool. the hotel does have a beautiful view of the mountains (it's impossible not to in Grindlevald) and the town itself is gorgeous. However, the location is on the far end of town, not near or on the main street—which is not ideal. For the price, this was a very poor choice.
Matthew C.	More important is the quality of the food. Belvedere Half Board is what I would call 4-star package tour quality. Multiple courses are produced, but they are neither creative haute cuisine, nor are they nourishing local cuisine. They are strange and often-insubstantial affairs, which in terms of ingredients cost the hotel very little.
Ying C.	The views should be wonderful but are disappointing—it is situated on a high promontory between two lakes in the Engadin Valley but none of this can be seen from the public rooms being totally obscured by trees.

7. Discussion

The results of sentiment and textual analyses undertaken in the present study demonstrate that there are different indicators for the management of the environment detected by travelers during their stay in hotels. Both hotel managers and directors should take these indicators into account to introduce policies that better support sustainability and the environment.

In this respect, it should be noted that the indicators of positive sentiment were those related to the characteristics of integration between the hotels and the surrounding environment, including the pure air in the facilities and surroundings, the absence of noise, and the abundance of nature and plants, in the hotel ecosystem. Likewise, with regard to positive factors, our results suggest that users tend to highlight the importance of routes and activities through nature and the rivers that surround them, as well as the respect of both employees and tourists to these wild spaces where there are animals in their habitat that should not be disturbed.

Likewise, another indicator related to the management of the environment refers to local traditions and local products. Hotels should take into account that users visiting their facilities should be made

aware of the fact that they are in a space that respects the sustainability of natural areas and, more generally, of local products and experiences.

In this sense, those indicators of environmental management of the views that travelers have from their hotel rooms are also positively valued as well as influence their perception that the hotel has respected the environment that surrounds it when the facilities are improved or by the construction of the hotel itself.

The factors that users perceive as negative in the management of the environment in hotels relate to noise and smoke pollution, or the very agglomeration of people in these spaces. In addition, a negative indicator for the management of the environment is that the hotel itself does not use or respect local products and local food traditions, a fact that maintains the importance of sustainability both locally and globally in the spaces in which the Hotel develops its activities.

In addition, users also tend to negatively perceive garbage, as well as smoke outlets from the hotels that pollute the surrounding natural spaces. Accordingly, users perceive these aspects as negative. Another negative indicator perceived by users is the hotel's sustainability policy regarding sustainable energy programs, use, and recycling of products or laundry at the request of guests, as well as the installation of solar panels or self-sufficiency in empty areas.

Hotel owners and relevant management staff should be aware of new technologies and the opportunities that these online platforms offer. Owing to social networks such as TripAdvisor, hotel management staff can learn first-hand what are the concerns of tourists and make decisions about it.

In addition, the fact that the reviews are related to the environment shows that users want to stay in hotels that are well aligned with their values and beliefs.

The indicators explored in the present study can improve the management of the environment in hotels, because they ratify some generalized beliefs, such as the fact that tourists are concerned about environmental sustainability. At the same time, our results also suggest the existence of new indicators that were not previously discussed in the literature, such as the fact that priority should be given to regional products, which would also have a positive impact on the economy of the region, as this would make it possible to avoid the unnecessary pollution caused by transportation from the place of production to the place of consumption.

8. Conclusions

The importance of the present study lies in the fact that the management of the environment is one of the key aspects of tourism both in Switzerland and in the rest of the world. Last year (2017) was the International Year of Sustainable Tourism, and some of the challenges posed by the World Tourism Organization of the United Nations (UNWTO) were precisely the efficiency in the management of resources, the protection of the environment, and the fight against climate change.

Following previous studies, the present research has shown that online reviews or e-WOM are a good source of information for decision making on the management of environmental indicators in hotels in Switzerland.

Regarding Hypothesis 1, our results demonstrate that travelers' reviews during their stay in Swiss hotels contain indicators related to environmental management and that these can also be used to improve hotel services related to sustainability and the environment that surrounds hotel facilities.

Likewise, with regard to Hypothesis 2, our results confirm that the sentiment of travelers' reviews also contains environment-related indicators that are perceived as positive, negative or neutral. In this way, we have identified that the indicators related to the environment and sustainability are both positive and negative.

Finally, with regard to Hypothesis 3, this hypothesis is supported by the results of sentiment analysis of a total of 7961 positive reviews showing that, in general, the predominant feeling of the reviews that contain indicators of the environment for Swiss hotels is positive.

Therefore, hotel managers can use the results of the present study to make better decisions about the management of key environmental indicators for hotels in Switzerland.

From the practical perspective, they can also better understand the possibilities offered by technology for the environmental management of their hotels. Owing to social networks such as TripAdvisor, those responsible for the management of the hotels can learn first-hand what the concerns of tourists are and make decisions accordingly.

In addition, the fact that the reviews are related to the environment shows a macro-tendency that is the concern for ecology, since users want to stay in hotels that are well aligned with their values and beliefs. Corporate Social Responsibility (CSR), transparency, and closeness combined with an ever-increasing level of commitment are the areas on which the managers of the hotels in Switzerland—and particularly those responsible for environmental management—should focus on.

The limitations of this study are related to the sample size that makes up the TripAdvisor reviews, the number of hotels analyzed, and the number of previous studies consulted.

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Conflicts of Interest: The authors declare no conflict of interest.

Appendix A

Table A1. Cards of the hotels in our sample.

Hotel	Location	TripAdvisor Starts	Customers Reviews
The Omnia	Zermatt, Switzerland	5.0	310
Cervo Zermatt	Zermatt, Switzerland	5.0	439
The Alpina Gstaad	Gstaad, Switzerland	5.0	250
Matterhorn Focus-Design Hotel	Zermatt, Switzerland	5.0	461
Park Hotel Vitznau	Vitznau, Switzerland	5.0	433
Art Hotel Riposo	Ascona, Switzerland	5.0	375
Beausite Park Hotel	Wengen, Switzerland	5.0	380
Le Grand Bellevue	Gstaad, Switzerland	5.0	487
Castello del Sole Beach Resort & SPA	Ascona, Switzerland	5.0	276
Europe Hotel & Spa	Zermatt, Switzerland	5.0	149
Romantik Hotel Hornberg	Saanenmoser, Switzerland	5.0	225
Atlantis by Giardino	Zurich, Switzerland	5.0	282
Hotel Eiger	Murren, Switzerland	5.0	317
Grand Hotel Kronenhof	Pontresina, Switzerland	5.0	585
Widder Hotel	Zurich, Switzerland	5.0	452
Parkhotel Beaut Site	Zermatt, Switzerland	5.0	406
Lugano Dante Center Swiss	Lugano, Switzerland	5.0	262
Giardino Ascona	Ascona, Switzerland	5.0	368
Schlosshotel Life & Style	Zermatt, Switzerland	5.0	201
Waldhotel Davos	Davos, Switzerland	5.0	117
Hotel Waldhaus	Sils im Engadin, Switzerland	5.0	170
Hotel Schweizerhof Bern & The Spa	Bern, Switzerland	4.5	322
Storchen Zurich	Zurich, Switzerland	4.5	420
Carlton Hotel St. Moritz	St. Moritz, Switzerland	5.0	262
Hotel Belvedere Grindelwald	Grindelwald, Switzerland	5.0	382

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