Understanding User Perspectives on Sustainability and Fairness in Tourism Recommender Systems

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Abstract

Recommender Systems (RS) are widely used in various domains, including travel and tourism, to provide personalized recommendations for accommodations, activities, and destinations. However, the evaluation of RS has traditionally focused on satisfying the needs of end users, item providers, or the recommendation platform itself without considering the impact on society. Sustainable tourism practices are becoming increasingly important, and a Tourism Recommendation System (TRS) can play a crucial role in promoting sustainability by suggesting sustainable activities and less popular destinations to users.

In this study, we explore the effect of integrating sustainable recommendations into TRS to ensure fairness for society. We conduct a user study utilizing synthetic recommendations to assess user perceptions of sustainable options versus unsustainable options. Our contributions include insights into effective strategies for incorporating sustainable items in recommendations, understanding user reactions to sustainable alternatives, and identifying helpful recommendation elements for users in their decision-making process. Our findings demonstrate that including sustainable options in recommendations can encourage tourists to visit sustainable and less popular areas and help address issues such as overtourism and undertourism in the travel and tourism industry.

Keywords

Tourism, Recommender Systems, Fairness, Sustainability, Society, User Perceptions

1 Introduction

Recommender Systems (RS) are extensively utilized in diverse domains, from e-commerce and social media to news and travel, providing users with personalized access to information and facilitating navigation through overwhelming content. Within the realm of travel and tourism, RS play a pivotal role in simplifying trip planning for travelers by offering personalized recommendations for destinations, accommodations, activities, and more [18]. In the past, evaluating the effectiveness of RS was mainly based on its ability to cater to the needs and preferences of end users. This approach was logical, as users would only use the system if it met their interests. However, it is essential to acknowledge that, in many cases, the end user is not the only stakeholder impacted by the recommendations.

Tourism is such a domain that involves various stakeholders beyond just the end user. These stakeholders include transportation providers, host destinations, and information platforms, each with unique needs and objectives [1]. For instance, host destinations may aim to attract many travelers. At the same time, information and booking platforms may strive to provide only information on destinations with better chances of successful transactions or higher provisions. A Tourism Recommender System (TRS) should therefore incorporate fairness objectives that can account for the (sometimes conflicting) needs of these different stakeholders and ensure fair outcomes for them. However, since tourism activities also impact the environment and society at large [17], constructing a TRS that considers fairness towards society and takes sustainable tourism principles into account is equally important.

Sustainable tourism is defined as "*tourism that takes full account of its current and future economic, social, and environmental impacts, addressing the needs of visitors, the industry, the environment, and host communities*" [15]. However, achieving sustainability in the tourism industry requires interventions at various levels, including municipal policies and regulations [36]. Despite such measures, tourists often need to be made aware of the environmental impacts of their activities or the sustainability issues of their destinations [11], leading to challenges such as overtourism and undertourism.

Overtourism is caused by well-known destinations getting overwhelmed by an excessive number of tourists, often caused by factors such as low-cost aviation, cheap transportation, social media popularity, and home-sharing platforms like Airbnb[1] [17], or visitors lacking awareness of alternative destinations and crowding at popular places [11]. The consequences of overtourism include harm to the environment and local communities, affordable housing availability, and traffic congestion in popular destinations. Whereas undertourism is caused by a lack of tourism with adverse effects

[1]https://www.airbnb.com

on the local tourism and hotel industries in lesser-known destinations [10, 16]. One effective intervention to mitigate the impacts of tourism is to regulate the influx of tourists to well-known and less-known regions. A TRS can be particularly valuable by recommending sustainable activities and less popular destinations to users and increasing their awareness of sustainable tourism practices. Despite its great potential, research has shown that there is a lack of emphasis on generating fair recommendations that address sustainability in the tourism industry [6].

To fill this gap, in this paper, we address the concept of Societal Fairness, namely S-Fairness. S-Fairness in the context of TRS refers to being fair to society by considering the environmental impacts through sustainability [5]. We explore the possible ways of incorporating sustainable recommendations into TRS to achieve S-Fairness and assess how users perceive them through a case study utilizing synthetic recommendations based on places in the city of Venice. To this end, our work makes the following three contributions:

- We gather insights on effective approaches for including sustainable items in recommendations to promote S-Fairness.
- We understand the influence of sustainability on users' acceptance of recommendations.
- We identify the elements of a recommendation most helpful to users in their decision-making process.

The paper is structured as follows: We introduce the concept of fairness for individual stakeholders in TRS and delve deeper into defining S-Fairness in our study in Section 2. Next, in Section 3, we elaborate on our study methodology, followed by a discussion of our findings in Section 4. Section 5, provides an overview of the existing literature on sustainable recommendations and fairness evaluation from the user's perspective. Finally, in Section 6, we conclude the paper and outline potential areas for future research.

2 Terminology

2.1 Fairness in TRS

There has been growing attention to fairness considerations in recommender systems (RS) in recent years. It has been acknowledged in research that fairness in RS is often closely tied to the presence of multiple stakeholders, such as end users, item providers, and platforms, as it raises concerns for the fair treatment of all parties involved [2]. Hence, fairness in RS is a multi-faceted concept that requires consideration of the perspectives and needs of the different stakeholders to ensure fair outcomes for them. However, there may often be instances where achieving the goals of one stakeholder could conflict with those of another, resulting in trade-offs [20].

We adopt the fairness terminologies used by Abdollahpouri and Burke [2] and use the notion of multiple stakeholders in tourism and their main fairness criteria, as discussed in Banerjee et al. [6], to demonstrate the close connection of multiple stakeholders with multi-sided fairness in the context of Tourism Recommender Systems (TRS) in Table 1.

As highlighted in Table 1, TRS encompasses various stakeholders, each impacted by different biases. For instance, end users using a TRS may have different individual preferences; some users might be looking for popular tourist attractions, while others might search for more low-key destinations. Recommending only popular items

or similar items to all individuals or groups of users may lead to unfairness not only for the users [13, 23] but can lead to popularity and exposure biases [3, 4] for the item providers who as a result are getting restrained from gaining a larger audience. On the other hand, the platform needs to fairly rank or distribute items in the recommendations, as ranking positions influence the amount of attention received by the ranked items from users and play an integral role in their decision-making [7]. Furthermore, tourism activities can impact the social and economic well-being of local communities and the environment [17], which makes it increasingly necessary to develop sustainability-driven TRS to ensure fairness for society. A TRS can be considered fair if it can mitigate these biases or circumstances that could lead to unfavorable outcomes for any stakeholder.

2.2 Societal Fairness in TRS

While many existing studies within TRS have primarily concentrated on achieving fairness for consumers, item providers, and platforms [29, 32, 37, 38], more attention must be given to generating sustainable recommendations and including society as a stakeholder in TRS. We address this gap in this paper by focusing on S-Fairness, which pertains to the concept of ensuring fairness to stakeholders who are indirectly involved in the recommendation process and are impacted by its outcomes [2]. In the context of tourism, it refers explicitly to Societal Fairness and its potential vulnerability to sustainability concerns concerning overtourism and undertourism. A TRS should therefore consider the impact of these challenges on the environment and the local communities when offering recommendations to tourists.

Our work considers a TRS as S-Fair if it recommends sustainable items to users and results in high user satisfaction and acceptance. We introduce this novel perspective of considering the generation and persuasion of sustainable recommendations as a means of being fair to society, as it involves minimizing the environmental impact of tourism. To promote S-Fairness, we categorized TRS recommendations into two groups— *sustainable* and *unsustainable*, as shown in Table 2. We assume a place or activity is *sustainable* if it is less popular with low ratings, has fewer reviews, is less crowded, or is reachable by public transport. Conversely, we assume *unsustainable* options as popular places with high ratings and more reviews, often overcrowded or inaccessible by public transport. This classification is based on our understanding that sustainable places tend to have lower footfall, resulting in fewer reviews and ratings. Unsustainable places are often overcrowded, attracting more visitors and receiving more reviews and ratings. Additionally, the accessibility of places via public transportation makes them a more sustainable choice compared to private transportation, which contributes to environmental pollution and carbon footprint.

3 Methodology

We conducted a user study to identify an effective way to incorporate sustainable items into recommendations and understand how well users perceive them in a real-world use case of TRS. Given Venice's well-known struggle with overtourism [31], we chose it as the backdrop for our study. We presented users with recommendation lists consisting of places to visit or activities to do there as the

Table 1: Table summarizing types of fairness, the impacted stakeholders, and their main fairness concerns in Tourism Recommender Systems, adapted from Banerjee et al. [6].

Fairness Type	Stakeholder Impacted	Fairness Concern
Consumer Fairness (C-Fairness)	Tourists who use the recommender system	Individual Discrimination [13] Group Discrimination [23]
Item Provider Fairness (I-Fairness)	City authorities and tourist sites	Popularity Bias [3] Exposure Bias [4]
Platform Fairness (P-Fairness)	Platform operator hosting the recommender system	Ranking Bias [7]
Societal Fairness (S-Fairness)	Local Communities and the Environment	Sustainability [36]

Table 2: Categorization of sustainable and unsustainable items

Sustainable	Unsustainable
<4 stars	>4 stars
<100 reviews	>100 reviews
Less crowded	Overcrowded
Low CO2 emissions	High CO2 emissions
Accessible by public transport	Only accessible by car

recommended items. The strategies employed in creating the recommendation lists and the user survey designed to evaluate them from the users' perspectives are discussed in detail in Section 3.1 and Section 3.2, respectively.

3.1 Recommendation Lists

Three non-personalized recommendation lists were created to include sustainable recommendations employing the three different strategies L1, L2, and L3. The lists were hard-coded but created as realistic mockups using the design tool Figma [2].

The primary aim of each list was to achieve S-Fairness by offering sustainable tourism recommendations to users and encouraging them to adopt sustainable practices. Each of the recommended items was created with distinct features to denote distinct properties, as demonstrated in Figure 1, Figure 2, and Figure 3. Sustainable items were distinguished with green labels to indicate their sustainability characteristics, low ratings, and fewer reviews to indicate their low popularity. Conversely, unsustainable items were marked with caution labels to indicate their adverse effects, and high ratings and numerous reviews to indicate their high popularity. Additionally, each recommendation was accompanied by a description that provided insights into the reasoning behind each label and offered information on the item's sustainability or unsustainability. The following outlines the approaches used to design each list:

Emphasizing Sustainable Options (L1): In this list, we present users with three choices for visiting tourist destinations in Venice, including at least one sustainable option in the list. This approach aims to highlight the presence of a sustainable recommendation amidst predominantly unsustainable options, with the intention of

directing users towards the more sustainable choice. The recommendation list presented to users as part of this approach can be seen in Figure 1.

Higher Proportion of Sustainable Options (L2): Our second recommendation list includes a higher proportion of sustainable options than unsustainable ones in the recommendation list, as depicted in Figure 2. This approach aims to explore if users are more inclined to choose environmentally-friendly options when presented with more sustainable options than unsustainable ones.

Sustainable Alternatives for each Unsustainable Option (L3): Finally, our third list entails offering an equal number of sustainable alternatives alongside unsustainable options. This approach examines whether presenting an equal number of sustainable and unsustainable options encourages users to choose sustainable options over unsustainable ones. To implement this approach, we created a recommendation list, as shown in Figure 3, consisting of four pairs of options, each featuring two recommendations where one served as an alternative to the other.

3.2 Survey Questionnaire

The survey was created using Qualtrics [3]. In the study, participants were put in the hypothetical position of someone looking for things to do in Venice. They were presented individually with each simulated recommendation list as designed in Section 3.1. The provided questions were asked to the study participants for each list:

3.2.1 Which one item do you choose from the provided list: Respondents were asked to select an option they preferred from each recommendation list. The primary objective of this question is to identify which of the three recommendation lists was an effective

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[2]https://www.figma.com/

[3]https://www.qualtrics.com/

Main City Square
★★★★★
2,133 reviews
⚠ *Overcrowded*

There are several Museums, National Library, Basilica, the Bell Tower and some other attractive tourist spots. It remains mostly crowded that impacts the quality of life of the residents.

Walk by Fondamenta Canal
★★☆☆☆
17 reviews
✅ *Less crowded*
🍃 *Environment-friendly*

A hidden canal that takes you on a quiet route with eateries filled with local people, thus an experience of the local culture with minimal carbon footprint.

Water Taxi Ride
★★★★⯪
1,675 reviews
⚠ *High CO2 emissions*

The water taxis (Vaporetto) are the main form of transport to experience the largest monumental canal of Venice from water. Vast amount of carbon emissions from its fuel contribute to air and water pollution.

Figure 1: Recommendation list (L1) emphasizing sustainable options in recommendations.

Vittorio Veneto Hike
★⯪☆☆☆
27 reviews
✅ *Accessible by public transport*
🍃 *Environment-friendly*

A nice walk in the hills with vast nature and historical significance. This hiking trail is reachable by local public transport thus you can utilize and support it by paying for tickets, as well as reduce your carbon footprint.

Grand Canal View from Rialto Bridge
★★★★★
1,001 reviews
⚠ *Overcrowded*

Ponte di Rialto is the most iconic bridge that spans the impressive Grand Canal. It is often over-touristed causing the infrastructure to overload.

Grand Canal View from Calle San Bernardo
★★★★★
1 review
✅ *Less crowded*
🍃 *Environment-friendly*

If you walk down the street of Calle San Bernardo, you will find yourself directly on the Canal Grande. Here you can admire a different and unique view of the most famous canal in Venice.
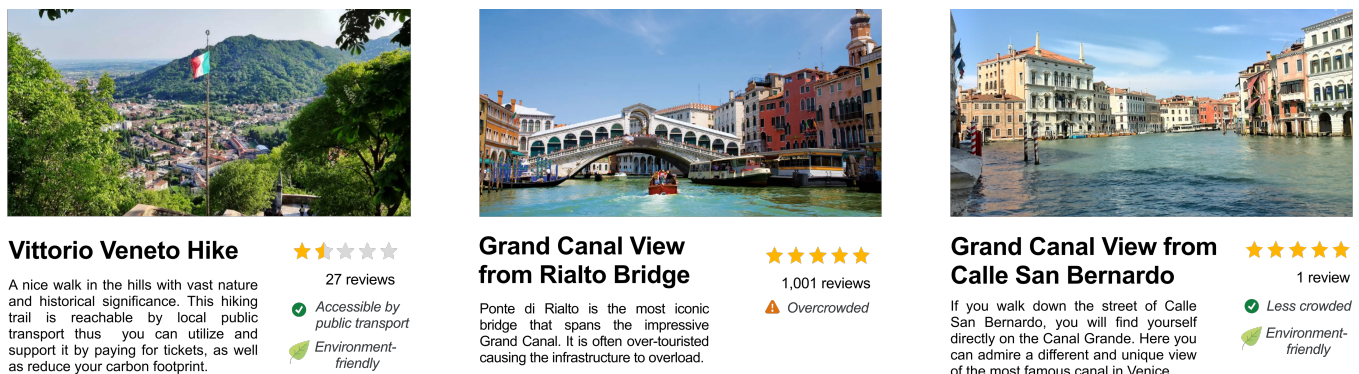
Figure 2: Recommendation list (L2) showing a higher proportion of sustainable options.

approach to include sustainable options. Suppose a recommendation list received more user selections for a sustainable option than an unsustainable one. In that case, the approach used in designing that list has effectively presented users with and persuaded them to choose sustainable tourism recommendations. Consequently, this indicates a high S-Fairness for society as users opting for sustainable tourism experiences minimize the adverse environmental impacts caused by tourism.

3.2.2   How satisfied are you with the provided recommendation list: Respondents were asked to rate their satisfaction with each list on a Likert scale [21] ranging from "extremely dissatisfied" to "extremely satisfied". This question aimed to gauge users' satisfaction with the recommended items provided in each list. If a recommendation list received a high number of positive ratings, this would indicate high user satisfaction for the list and, consequently, would mean that the list could effectively meet the preferences of users with both popular and niche interests.

3.2.3   You chose this item from the list because: Respondents who chose a sustainable option were presented with a set of statements to rate their level of agreement or disagreement on why they selected the given option. The reasons provided as options included the factors of environment-friendliness, less crowdedness, or accessibility via public transport, depending on the specific properties of

the sustainable item they chose. The main objective of this question is to dig deeper into understanding which sustainability factors persuaded users to select a sustainable item.

3.2.4   How helpful each element of the provided recommendations was in the process of making choices: In this question, respondents were given the following elements as options: ratings and reviews, descriptions, green labels, and caution labels; and were asked to rate based on their overall survey experience on how much they agreed or disagreed that each of these elements aided them in their decision-making process. A high number of positive responses for a specific element would suggest that the element assisted users in making informed choices and, therefore, can be helpful to incorporate into the tourism recommender system's design.

4   Experimental Evaluation

The survey was distributed online through various channels such as forums, message boards, and social media posts between February-March 2023. This approach enabled us to collect responses from a broad and diverse user base. In total, we obtained 103 responses, which were utilized to analyze the data collected. It is important to note that no personally identifiable information or demographic data was collected for this study. We assess the outcomes of our
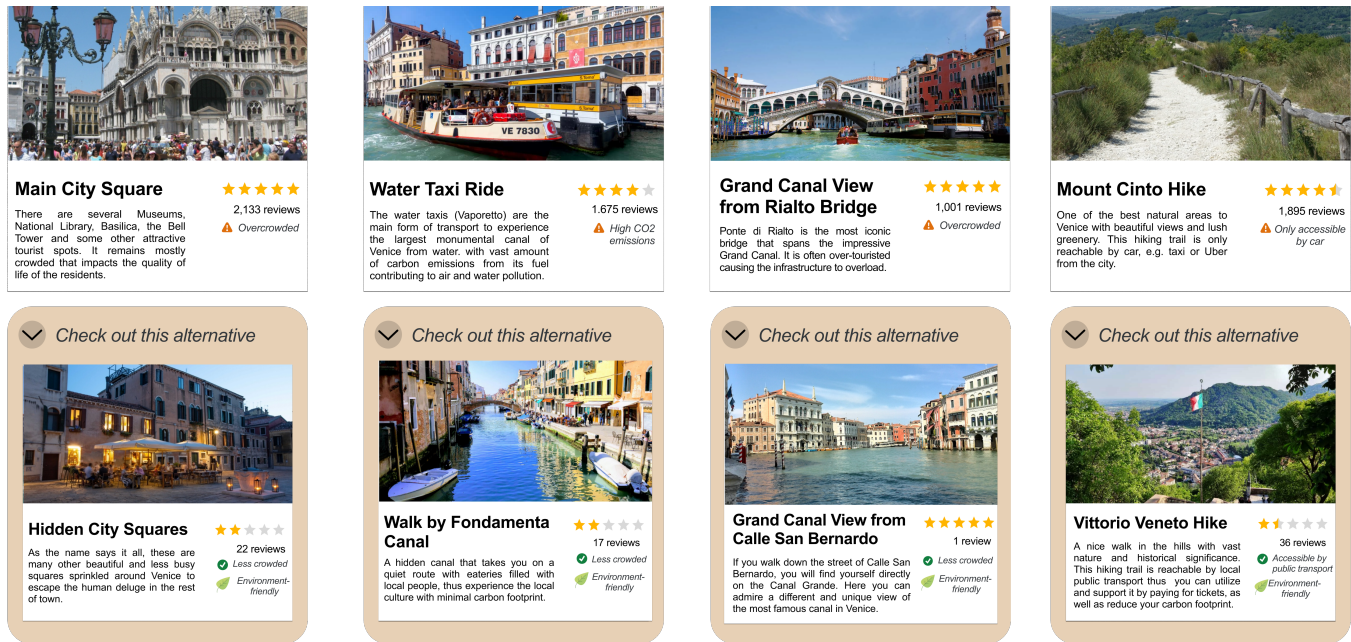
Figure 3: Recommendation list (L3) providing a sustainable alternative for each unsustainable option.

study in three primary aspects: the effectiveness of the recommended lists in integrating sustainable options and promoting fairness for society in Section 4.1, the influence of various sustainability factors on users' preferences in Section 4.2, and the usefulness of the different recommendation elements in assisting users' decision-making in Section 4.3.

4.1 Effectiveness of the Recommendation Lists in Terms of S-Fairness

4.1.1 L1: We compared the number of participants selecting each of the recommended items from L1, which presented users with at least one sustainable option. Figure 4a shows that despite the sustainable option having only a one-third probability of being chosen, the highest percentage of participants (51 out of 103, or 49.5%) opted for the sustainable option over the two unsustainable options. This suggests that this recommendation list could indeed effectively highlight the presence of the sustainable option and draw a greater proportion of users toward it. As a result, it can be inferred that L1 could achieve a high S-Fairness.

4.1.2 L2: Examining the results of L2, which offered users a greater number of sustainable options, it can be observed in Figure 4b that the sustainable option *Grand Canal View from Calle San Bernando* received the highest number of user selections. However, the difference in the selection rate between it and the unsustainable option only differed by a small margin. This indicates, given the lower probability of the unsustainable option being chosen, a high proportion of users (more than one-third) still preferred this option. As a result, it can be inferred that despite L2 having more sustainable items in the list than L1, S-Fairness did not increase proportionally.

4.1.3 L3: Analyzing the number of responses obtained for each recommended item in L3, which provided users with an equal number of sustainable options as alternatives to unsustainable options, the results depicted in Figure 4c reveal that despite all items having an equal probability of being selected, the top two highest proportion of user selections were for sustainable items. It could be due to how the sustainable options were presented as alternatives, allowing users to weigh the pros and cons of each option more efficiently and, thus, helping them make more informed and sustainable choices. This could suggest that L3 effectively presented users with and persuaded them to choose sustainable items over unsustainable ones, indicating a high S-Fairness.

4.1.4 User Satisfaction: Examining the ratings of users on their satisfaction with each recommendation list, it can be observed in Figure 4d that L3 was the most satisfactory list among users, with the highest proportion of users agreeing being satisfied and the lowest proportion of users with being dissatisfied, followed by L2 and L1 respectively. This suggests that L3 was able to effectively cater to the preferences of most users, as it provided a balanced presentation of both sustainable and unsustainable items, as well as popular and less popular items. This balance and way of presentation likely appealed to users with different interests and preferences, making it being more satisfactory for them.

Overall, as the results indicate that L3 received the highest level of user satisfaction than the other two lists, we could infer that providing users with an equal number of sustainable options as alternatives to unsustainable options resulted in the most effective method in our experiment to achieve S-Fairness with the highest satisfaction of users.
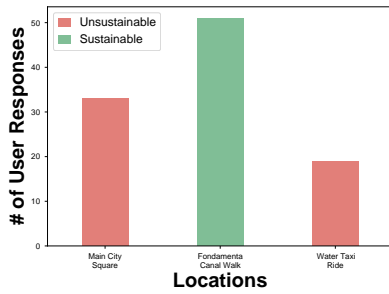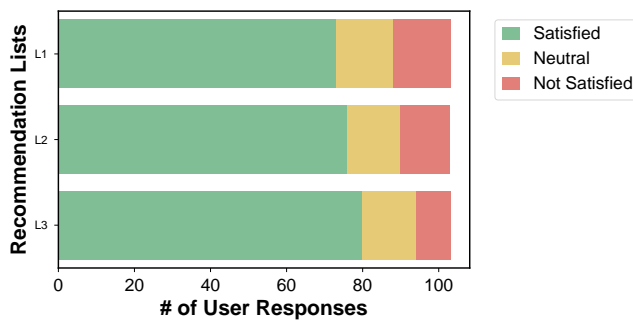
(a) L1
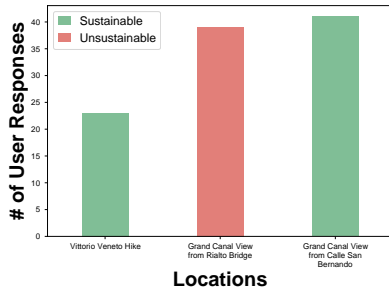
(b) L2
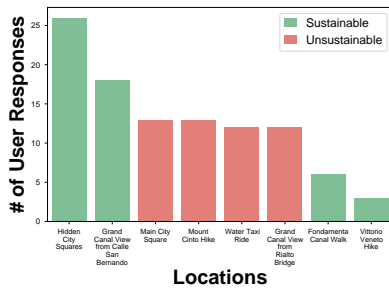
(c) L3

(d) Users' rating for satisfaction with the lists.

Figure 4: Overall distribution of user responses for each recommendation list.

Table 3: Summary statistics for the sustainability factors influencing users towards sustainable items

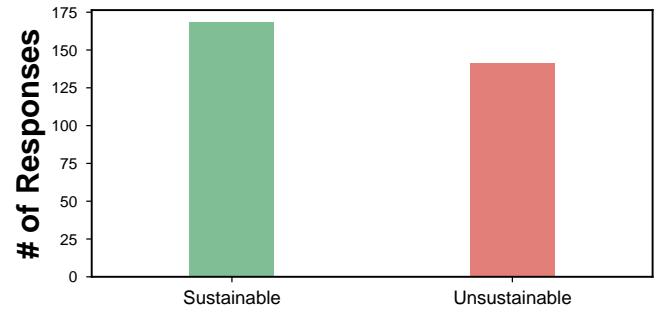| Sustainability factor	L1	L2	L3	Total mean
Environment-friendliness	3.98	3.95	3.89	3.94
Less crowded	4.55	3.08	4.08	3.90
Accessibility by public transport	-	2.06	1.17	1.62

Figure 5: Aggregated response rates from all three strategies.

4.2 Influence of Sustainability on Users

We created Table 3 to determine the extent of influence of each sustainability factor on users' choices of sustainable items. The numbers in the table indicate the mean responses from users on how much they agreed or disagreed with each factor's influence on their choice. The results show that environment-friendliness and less crowdedness had a greater impact (>3) on users' sustainable decisions in all three lists. In contrast, the factor of accessibility by public transport had a relatively lower impact (<3) on users' sustainable choice in both L2 and L3 when this option was provided. This suggests that sustainable items accessible by public transport were the least preferred among users when this option was available to them. This could be because traveling by public transport may only be convenient for some users, despite its environmental sustainability benefits, indicating the need for more effective strategies to encourage users to choose public transportation over cars.

Overall, to grasp how users responded to the sustainable options, we compared the total selection rate for sustainable options to unsustainable options from the three lists in aggregate. Figure 5 shows, that sustainable options received more than half (54%) of user responses, while unsustainable options received 46%. This suggests that a high portion of the audience is interested in sustainable options and considers them when presented in recommendation lists. Therefore, presenting sustainable options can be a viable and effective addition to TRS.

4.3 Usefulness of the Recommendation Elements in Users' Decision-making

Finally, examining users' ratings on the helpfulness of each element, as shown in Figure 6, ratings and reviews were found to be the most helpful element, with approximately 87% of users agreeing,

followed by descriptions agreed upon by 84.5% of users. This suggests that, besides reviews and ratings, a large proportion of users found the descriptions helpful, indicating that including explanations of why an option is sustainable or unsustainable is efficient for users to understand the reasoning behind these labels, and make well-informed decisions. The next most helpful element, with approximately 71% of users agreeing, was the caution labels e.g., "overcrowded," followed by the green labels, e.g., "less crowded," which comparatively received agreement from a 15% lower proportion of users. This suggests that the cautions were more helpful to users in making their choices, indicating it to be an effective labeling strategy to persuade users towards sustainable items. This could be due to the fact that negative labels can raise awareness of sustainability among users by providing specific information about what to avoid, which may be overlooked by users if only positive labels are used as they may be seen as less urgent or important to act on.

5 Related Work

Fairness in recommendations has been a research subject across diverse domains, such as music, movies, and tourism [8, 9, 22, 27, 29, 30, 32, 34, 37, 38]. The topic has been extensively surveyed in literature, such as by Deldjoo et al. [12] and Wang et al. [35], where the authors outline fairness methods in recommendations and classify fairness issues from various domains and perspectives. Another recent survey by Jannach and Abdollahpouri [19] sheds light on the conflicting factors in a multi-objective RS. Further, it emphasizes the challenge of fairness in RS as a societal construct. We refer to these survey papers for a more detailed review of the existing literature on fairness in RS.

In the rest of this section, we discuss existing literature across two key dimensions: addressing sustainability in TRS in Section 5.1 and dealing with fairness concerns from the user's perspective in Section 5.2.

5.1 Sustainable Recommendations

Previous studies have primarily centered on generating fair recommendations for consumers, item providers, or the recommendation platform but have yet to incorporate society's contributions as a stakeholder adequately. However, in recent times, there has been a growing focus on developing RS that prioritizes sustainability, explicitly addressing the issues of overtourism and undertourism. A study by Merinov et al. [24] introduced a multistakeholder utility model for travel itinerary optimization. This model aims to distribute tourists across different points of interest (POIs) to protect popular destinations from overcrowding and less popular destinations from being overlooked. The model considers user preferences from the consumer side and time and occupancy of POIs from the environmental side as two objectives and optimizes the trade-off between the two using a greedy breadth-first search graph method. The authors demonstrated the effectiveness of their approach to synthetic data using simulated scenarios in an Italian village.

Another study by Patro et al. [28] proposed a multi-objective optimization approach to address the challenges of over and undertourism in TRS. This approach focuses on improving business sustainability, safety, and utility goals. Additionally, Pachot et al. [26]

proposed a novel RS incorporating sustainability tourism practices such as diversity, territorial policies, and competitive advantage for local providers. These studies highlight the growing interest in developing RS solutions that align with sustainable tourism principles and consider the needs of different stakeholders involved in the tourism industry.

5.2 Fairness from Users' Perspective

Lately, there has been an increased awareness of evaluating RS's fairness from the users' perspective. For instance, Sonboli et al. [33] emphasized the importance of transparently communicating fairness goals to users to enhance their understanding and trust in fairness-aware RS. Elahi et al. [14] introduced metrics for evaluating user-perceived fairness in RS and proposed a survey questionnaire to evaluate systems based on these metrics. In addition, Mousavifar and Vassileva [25] conducted a user study that demonstrated the positive impact of explanations on user satisfaction with a music RS while promoting exposure for less-known artists.

Despite the usefulness of user perspectives for evaluating fairness in RS, there needs to be more research on applying this to tourism. This paper fills this gap by conducting a user study to evaluate how users respond to sustainable and fair tourism recommendations. Our approach distinguishes itself from existing work, emphasizing sustainability in TRS to achieve S-Fairness by evaluating the user's acceptance of the recommended results.

6 Conclusion

Fairness has become an increasingly important concern in TRS as it involves meeting the needs of the different stakeholders, including the end-users, providers, and the recommendation platform itself. However, there needs to be more research into integrating society as a stakeholder and addressing fairness for them. One way to address this gap could be to include sustainable activities and lesser-known destinations as recommendations to ensure fair outcomes for society. Through a user study, we have explored potential ways to achieve this.

Based on our user study, we found that providing an equal number of sustainable options alongside unsustainable options in recommendation lists resulted in a high selection rate of sustainable items with the highest satisfaction rate of users. Additionally, explanations on the sustainability or lack thereof of each option and labeling options with caution signs were found to be effective strategies to guide users toward making sustainable choices. Interestingly, environment-friendliness and less crowdedness were found to have more significant impacts on users' sustainable choice, compared to accessibility by public transport which was preferred the least among users. Altogether, sustainable items were found to receive notably a higher selection rate from users than unsustainable items, indicating that travelers are willing to consider sustainable alternatives even if they are less well-known compared to unsustainable and popular options in principle.

However, it is essential to acknowledge that our study is preliminary and has certain limitations. One area for improvement is that it is based on synthetic, non-personalized recommendations, which may not fully capture the complexity and nuances of real-world TRS. Synthetic recommendations are generated based on predefined
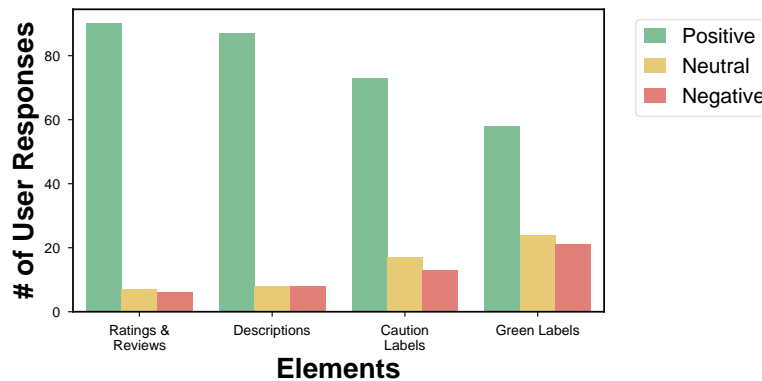
Figure 6: Elements of recommendations that were overall most helpful to users in making their choices in descending order.

criteria and do not consider actual user preferences or behavior. Furthermore, our current definition of *"Sustainability"* may be debatable and requires further refinement in future research. While low ratings alone may not serve as the exclusive determinant of sustainability, they can provide insights into less popular destinations or activities that have the potential to be more sustainable. These options should be taken into account when promoting responsible and environmentally conscious tourism practices. Therefore, it is vital for future research to build and evaluate recommendation systems using real-world datasets that capture actual user interactions, preferences, and behaviors.

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