

Exploring tourists' pro-environmental behavior: a bibliometric analysis over two decades (1999–2023)

Elena Carvajal-Trujillo, Jesús Claudio Pérez-Gálvez and Jaime Jose Orts-Cardador

Abstract

Purpose – The main objective of this article is to visualize the structure and trends of pro-environmental behavior (PEB) between 1999 and 2023 through mapping and in-depth analysis. The aim is to analyze PEB, which has received considerable academic attention in recent years due to its key role in the conservation of the environment and the protection of local communities in tourist destinations. This paper provides an important summary of the recent research that has explored the role that tourists have in protecting the environment through PEB.

Design/methodology/approach – This study presents a visual analysis of 2005 scholarly articles between the years 1999 and 2023 related to PEB. Using the knowledge mapping based on VOSviewer it presents the current status of research, which includes the analysis of citation analysis, co-citation analysis, co-citation network and longitudinal analysis.

Findings – PEB is an emerging topic due to its relevance to protecting the environment in the context of travel. The citation and co-citation analysis show the relevance of the behavior of tourists with regard to protecting the environment. The co-word analysis highlights the current significance of research concerning green hotels and the destination image of environmentally responsible destinations.

Originality/value – This study sheds light on the current research progress of PEB in the context of tourism through a comprehensive analysis (citation, co-citation and co-word). In addition, we provide theories and factors that have been previously used to study PEB in the context of tourism. The findings contribute to a broad and diverse understanding of the concept of PEB, which can provide important insights for policymakers in formulating management strategies and policies aimed at reducing environmental impacts in destinations.

Keywords Bibliometrics, Sustainable tourism, Pro-environmental behavior (PEB), Green hotels, VOSviewer, Web of Science

Paper type Research paper

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1. Introduction

Traditionally, the success of tourism has been evaluated based on the economic results obtained by the industry and growth indicators for the region, such as employment generated, tourist arrivals and business creation (Koh *et al.*, 2022; Fakfare and Wattanacharoensil, 2023). Although these measures have been commonly accepted by tourism professionals as a benefit (Fakfare and Wattanacharoensil, 2023), in recent years different negative externalities around this industry have been highlighted, such as overcrowding in traditional destinations (World Travel and Tourism Council, 2021), excessive energy consumption (Shakouri *et al.*, 2017) or the emission of greenhouse gases into the atmosphere (Mishra *et al.*, 2022). Specifically, the World Travel and Tourism Council (WTTC), the United Nations Environment Programme (UNEP), and the United Nations Framework Convention on Climate Change (UNFCCC) (2021) in its “net zero” report, estimate that tourism has emitted in 2019 a range of 8%–11% of total carbon outputs in the last

decade, which means 3.9 to 5.4 billion tons of CO₂ emissions. Furthermore, the United Nations World Tourism Organization (UNWTO) and the International Transport Forum (ITF) in their latest report, which analyze the transport-related CO₂ emissions of the tourism sector, forecast a 25% increase in emissions in 2030 and, specifically, a 45% increase in international travel (UNWTO, 2019). It is noteworthy that the responsibility for the negative impact of tourism cannot only be addressed by public authorities and tourism destination managers, as the responsibility of tourists also comes into play (Juwan and Dolnican, 2016). Therefore, inciting tourists to behave in an environmentally friendly manner has attracted the attention of researchers in recent decades (Han et al., 2021; Lin et al., 2022), as it can help environmental conservation and enable a balance between tourism development and the sustainable capacity of environmental protection (Gao et al., 2021c).

Due to the influence that tourists' behavior has on the environment, tourists' pro-environmental behavior (PEB) has attracted increasing interest in recent years (Han and Hyun, 2018; Gao et al., 2021c). In general terms, PEB refers to those behaviors of individuals that minimize the negative effects of human activity on the environment (Kollmuss and Agyeman, 2002). It consists of "any actions that protect the environment or minimize the negative impacts of human activity on the environment in either general daily practice or specific outdoor settings" (Miller et al., 2015, pp. 28). The term "pro-environmental behavior" encompasses a broad range of actions and other terms are also used in the literature (Kiatkawin and Han, 2017). Thus, due to the nonexistence of a unified concept in the literature, in our study we will apply the following terms as synonyms (Lin et al., 2022). Thus, terms such as "pro-environmental intention" (Han and Hyun, 2018), "environmental responsibility behavior" (Confente and Scarpi, 2021), "environmentally friendly behavior" (Du et al., 2020), "environmental protection behavior" (Lin et al., 2022) or "sustainable environmental behavior" (Wu et al., 2020) are used interchangeably in the literature to identify human behaviors that benefit the natural environment.

Specifically, in the tourism and hospitality field, tourists who have a PEB are those who try to reduce negative impacts on the environment by striving for its preservation and conservation during their tourism activities (Lee et al., 2013). Moreover, tourists' PEB not only refers to the protection of the ecological environment of the destination (Gao et al., 2021c), but also includes nonmaterial elements of the destination such as respect for local people and local culture (Kock et al., 2019). Research on tourists' PEB is complex, as situational factors can reduce their motivation to behave responsibly (Liu et al., 2014). Thus, tourists behave differently than they do at home, which may contribute to lower PEB in the tourism context (Untaru et al., 2016). This has led to an interest in recent years by researchers in analyzing factors influencing consumer pro-environmental behavioral intentions in the tourism and hospitality context (Han and Hyun, 2018; Gao et al., 2021c).

Bibliometrics is a statistical analysis of those publications in a specific field of knowledge, which allows the information contained in a particular database to be analyzed (Van Raan, 2005; Leung et al., 2017). The results obtained from a bibliometric analysis are key to evaluating the knowledge of a scientific field from the observation of its growth, maturity and future lines of research (Agramunt et al., 2020). It is used in numerous researches in tourism (Pelit and Katircioglu, 2022), such as in co-creation (Liu et al., 2022), tourism ethnocentrism (Orts-Cardador et al., 2023), smart tourism (Chen et al., 2022), management (Fauzi, 2023), tourism crisis (Jiang et al., 2019), gastronomy (Sánchez et al., 2017), social media (Leung et al., 2017) or medical tourism (de la Hoz-Correa et al., 2018), among others. However, the number of bibliometric studies focused on the PEB of tourists is scarce. First, the study by Zhang and Quoquab (2022) does not show the most influential articles through citation analysis. Furthermore, these authors recommend that future studies expand the scope of research by adding more keywords. In this regard, we added other words, such as *environmental responsibility behavior*, *environmentally friendly behavior*, *environmental protection behavior* or *sustainable environmental behavior*. Other studies (Lu et al., 2021; Farrukh et al., 2023; Goyal and Goyal, 2024) that analyze PEB through bibliometrics do not analyze the same clusters as this manuscript. Specifically, this studies do not exhibit the PEB in

the specific field of tourists, being general analyses of PEB. For example, the results of the study of [Goyal and Goyal \(2024\)](#) shows that future studies analyze new topics which are intrinsic related with PEB, such as sustainable hotels, which we have analyzed below. Moreover, [Farrukh et al. \(2023\)](#) recommends that future studies would realize a bibliometric analysis to provide an in-depth analysis of the themes and trends of the field, contrary to these articles which perform a superficial analysis of the clusters. Finally, contrary to these articles, this study shows the co-citation analysis of keywords, which appears in other relevant bibliometric analyses ([Khanra et al., 2021](#); [Ogretmenoglu et al., 2022](#)) and helps researchers to show the theoretical underpinnings of PEB. Finally, [Farrukh et al. \(2023\)](#) recommend that future studies integrate theories and factors that can explain PEB in tourism. However, to the best of our knowledge, to date there is a dearth of review papers which analyze the theories and factors that have been used to study PEB in the context of tourism. In doing so, we provide a systemic and objective overview of these theories and factors on PEB in tourism. Aiming to have an in-depth understanding of the factors and theories influencing tourists' sustainable pro-behavior, this bibliometric analysis is an opportunity to synthesize previous knowledge on this topic and suggest future research topics. Thus, this study makes an important contribution to the literature for researchers, scholars and tourism managers to understand tourists' PEB and changing mindset over the last decade.

PEB is a topic that requires in-depth research in the tourism field in a context in which CO₂ emissions, environmental pollution and climate change have become important issues in society ([O'Connor and Assaker, 2021](#)). It is expected that scientific production will continue to grow in recent years due to two reasons: firstly, tourists are more demanding and aware of environmental values in tourism; and, secondly, tourism destinations see sustainability as a competitive advantage ([Budeanu, 2007](#); [Su et al., 2020](#)). Therefore, the present study attempts to understand the problem in depth using knowledge mapping through VOSviewer. The main objective of this article is to analyze the structure and trends of PEB of tourist's research between 1999 and 2023. The choice of 1999 as the start of the search period is due to the fact that the first article that relates both concepts is that of [Root and Schintler \(1999\)](#). Specifically, this article analyzed the role which has the women in the protection of the environment through the sustainable transport. From the collection of documents in WoS, VOSviewer has made it possible to visualize citation networks, co-citation reference networks, keyword co-occurrence networks and relevance boundaries and longitudinal analysis. These analyses make it possible to achieve the following intermediate research objectives:

- O1. Analyze the main documents, countries, universities, journals and authors in the field of PEB of tourists.
- O2. Define the most influential articles in the field of PEB of tourists through citation analysis.
- O3. Define the documents that have mainly contributed to the intellectual structure over time in the field of PEB of tourists through co-citation analysis.
- O4. To evaluate thematic clusters and emerging trends for future studies in the field of tourists' PEB through keyword co-occurrence analysis and longitudinal analysis.

The contribution of this study is twofold. First, from the citation and co-citation analysis, we present results that enable a better understanding of the development of research on tourists' PEB. Second, the results identify future lines of research that will allow a better understanding of tourists' behavior due to the keyword co-occurrence analysis.

2. Literature review

2.1 Pro-environmental behavior

The concept of PEB emerged in the 1960s as a result of scholars' reflections on the environmental problems caused by humans ([Maloney et al., 1975](#)) and the growing interest in environmental studies in academic and scientific communities ([Ellen et al., 1991](#)). [Maloney et al. \(1975\)](#) posited

that irresponsible behavior with the environment is a consequence of maladaptive behavior and urged stakeholders, politicians and scholars to analyze human behavior and encourage individuals to perform in an environmentally responsible manner (Lu *et al.*, 2021). According to Shafiei and Maleksaeidi (2020), the first studies analyzing PEB in the mid-1960s were related to measuring public concern about environmental quality (Li *et al.*, 2019). Gradually, by increasing public interests for studying environmental behaviors and the growing societal concern about society's negative impact on the environment, questions about factors triggering the acceptance of environmentally friendly behaviors occupied the researchers' mind (Casaló and Escario, 2018). Therefore, PEB is defined as purposeful actions that can be undertaken to minimize the negative impact of human behavior on the environment (Kollmuss and Agyeman, 2002; Wu *et al.*, 2021a). This active participation is captured in the literature by the term PEB, which refers to "any action that protects the environment or minimizes the negative impact of human activities on the environment, either in general daily practice or in specific outdoor environments" (Miller *et al.*, 2015). The concept is broad and encompasses a wide range of behaviors such as saving resources including energy or raw materials, using alternative energy, avoiding car travel, using alternative transportation, reusing paper, plastic or water and properly disposing non-recyclable waste (Shen *et al.*, 2024).

2.2 Tourism pro-environmental behavior

Climate change is a major challenge for the development of tourism, as it will determine its economic activity in the coming years (Cho *et al.*, 2016; Zha *et al.*, 2019), especially when tourism is one of the main industries producing greenhouse gas emissions and contributing to climate change (Hall *et al.*, 2013; Gössling *et al.*, 2016). From a business management perspective, different tourism services (hotels, cruises, aircraft . . .) have implemented different environmental strategies with the aim of being in line with sustainability (Kularatne *et al.*, 2019; Nepal *et al.*, 2019). However, sustainable practices by tourists are equally important and should not be ignored (Wang *et al.*, 2020b). Therefore, the active participation of tourists in environmental activities is a key factor in the implementation of sustainable practices (Kiatkawsin and Han, 2017). OConner and Assaker (2021) defined PEB in tourism: "PEB refers to pro-environmental behavior with respect to traveling less, traveling closer to home, traveling less by plane, choosing a destination, selecting transportation, choosing accommodations, making attractions and activity choices, and making more sustainable choices of tourism products in general." (P. 8). Furthermore, tourists' PEB not only refers to the protection of the destination's ecological environment through practices such as water and electricity consumption, use of public transport, littering, waste recycling and reusing plastic bottles (Gao *et al.*, 2021c), but also includes nonmaterial elements of the destination such as respecting local people and local culture (Kock *et al.*, 2019). In this regard, the ongoing debates in the academia in order to analyze how policymakers and destination managers can influence in the awareness of the tourists have concluded that the attachment to a place have a positive relationship in the protection of the environment (Lin *et al.*, 2022). Finally, another current issue is the sustainable mobility in tourism because has an important role to promote PEB among tourists, such as the use of electric, public or zero emission vehicles. The results of the study by Zamparini and Vergori (2021) show that the introduction of new infrastructures or their improvement have a relevant impact on the sustainability of mobility in tourism in the short term and an improvement in tourist demand in the long term.

Research on tourists' PEB is complex because situational factors can reduce their motivation to behave responsibly (Liu *et al.*, 2014). For example, tourists behave differently than they do at home, which may contribute to lower PEB in the tourism context Untaru *et al.*, (2016). However, the results of Wu *et al.* (2021a) show that tourists have a higher PEB in the tourist context than at home because there are more facilities than in their everyday home environment. As a result, in recent years researchers have been interested in analyzing the different antecedents that influence consumers' PEB in the context of tourism and hospitality. In this regard, different authors have analyzed these antecedents based on different theories or of different normative, affective or habitual factors.

2.3 Theories of PEB in tourism

Different researchers have explored the notion of PEB in tourism based on different theories. One of the most influential theories has been the theory of planned behavior (TPB) (Ajzen, 1991), which modifies the theory of reasoned action (Ajzen and Fishbein, 1980); TPB states that behavior can be predicted by intention to act, where intention is determined by attitude toward the behavior, subjective norms and perceived behavioral control. For example, Liu *et al.* (2020) suggested that environmental attitudes and environmental behavioral intentions may play a mediating role in the relationship between environmental knowledge and PEB. Green consumer values (GCVs), which build on the foundation of consumer value theory, are defined as a person's tendency to express their own environmental protection values through their purchasing and consumption behavior (Haws *et al.*, 2014). For example, Ribeiro *et al.* (2023) showed how green consumer values moderate the relationship between attitudes to pro-environmental travel and willingness to sacrifice in relation to PEB.

The norm activation model (NAM) was developed by Schwartz (1977), which states that personal norms predict behavior and are determined by three factors: the awareness of performing a particular behavior; the feeling of responsibility for performing that particular behavior and personal norms. For example, Han *et al.* (2018b) showed that NAM is an appropriate theory to analyze tourists' PEB, where awareness of consequences and attribution of responsibility are two prerequisites for personal norm activation and PEB. The value-belief-norm (VBN) theory was developed by Stern *et al.* (1999) and is based on three components: values, beliefs and norms. Values are represented by the altruism value, the biospheric value and the egoistic value; beliefs are represented by the new ecological paradigm, awareness of consequences, ascription of responsibility; and norms are represented by the pro-environmental personal norm.

The classical expectancy theory of motivation (ETM), developed by Vroom (1964), is a theory that has been widely used in the field of tourism with the aim of analyzing tourists' motivation when choosing the type, destination and activities of their holidays (Hsu *et al.*, 2010). Both theories were integrated into Kiatkawsin and Han's (2017) model to predict tourists' PEB intention, with both integrated theories having a higher predictive power of 12.8% than using VBN alone as a predictive theory. Another theory is that of moral disengagement (MD), which was first proposed by Bandura *et al.* (1996), whereby people are able to justify their behaviors without suffering from guilt and distress. People tend to engage in prosocial behavior because it is consistent with their internal moral standards. In consequence, people with higher MD levels are less inclined to engage in prosocial behaviors (Bandura *et al.*, 1996). In relation to this theory, Wu *et al.* (2021b) find a negative relationship between MD and PEB. This is due to the fact that some tourists argue that their personal behavior has little impact on the environment (Gössling *et al.*, 2009), or use benefit comparison to minimize the negative impact they cause and to console themselves (Juvan and Dolnicar, 2014). Finally, the contingent valuation model (CVM) was introduced by Ciriacy-Wantrup (1947) to estimate nonuse values and can be used to estimate both use and nonuse values. This model was used by Linnes *et al.* (2022) to analyze whether local tourists would be willing to pay a higher price to buy locally grown food. Table 1 allows us to organize and synthesize the different theories in order to organize the main themes in which the literature has analyzed PEB in tourism:

2.4 Factors of PEB in tourism

These theories normally are generally identified in the literature through internal factors, external factors or personal factors (Li *et al.*, 2019). Among existing studies, the most investigated dimension is internal factors (Wu *et al.*, 2021a): normative factors (e.g. descriptive norms, moral norms, imperative norms, injunctive norms, religiosity), cognitive factors (environmental concern, environmental value, environmental awareness, willingness to sacrifice, self-efficacy or environmental knowledge), affective factors (e.g. anticipated pride and guilt) and habitual factors (e.g. water saving and towel reuse in daily life) – as important motivators for tourists to

Table 1 Main theories of PEB in tourism	
Theories	Articles
Theory of planned behavior	Han <i>et al.</i> (2010), Kim and Han (2010), Greaves <i>et al.</i> (2013), Chen and Tung (2014), Park and Ha (2014), Han (2015), Han and Yoon (2015), Gao <i>et al.</i> (2016), Chen and Hung, 2016, Han <i>et al.</i> (2017), Lanzini and Khan (2017), Shin <i>et al.</i> (2018), Wang <i>et al.</i> (2018), Kim <i>et al.</i> (2019), Liu <i>et al.</i> (2020), Shalender and Sharma (2021), Patwary <i>et al.</i> (2023), Wang <i>et al.</i> (2024)
Green consumer values	Han <i>et al.</i> (2015), Han <i>et al.</i> (2017), Wang <i>et al.</i> (2018), Han <i>et al.</i> (2019), Verma <i>et al.</i> (2019), Gupta <i>et al.</i> (2019), Han (2020), He and Filimonau (2020), Tan <i>et al.</i> (2020), Sarmento and Loureiro (2021), Wang <i>et al.</i> (2021), Fauzi <i>et al.</i> (2023), Wang <i>et al.</i> (2023), Ribeiro <i>et al.</i> (2023), Chaturvedi <i>et al.</i> (2024)
Norm activation model	Han and Hwang (2016), Han <i>et al.</i> (2017), Han <i>et al.</i> (2018a, b, c), Park <i>et al.</i> (2018), Kim and Kim (2018), Han <i>et al.</i> (2019), Li and Wu (2019), Han (2020), Denley <i>et al.</i> (2020), Tang <i>et al.</i> (2021), Yan and Chai (2021), O'Connor and Assaker (2022), Kang (2022), Chi <i>et al.</i> (2023), Dada <i>et al.</i> (2024)
Value-belief-norm	Han (2015), Han and Hwang (2017a, b), Han <i>et al.</i> (2018a, b, c), Park <i>et al.</i> (2018), Landon <i>et al.</i> (2018), Gupta <i>et al.</i> (2019), Hwang <i>et al.</i> (2020), Denley <i>et al.</i> (2020), Sharma <i>et al.</i> (2021), Le <i>et al.</i> (2021), Sarmento and Loureiro (2021), Lee <i>et al.</i> (2021), Zarey <i>et al.</i> (2021), He <i>et al.</i> (2023), Waris <i>et al.</i> (2024)
Classical expectancy theory of motivation	Horng <i>et al.</i> (2014), Moghimehfar and Halpenny (2016), Kiatkawsin and Han (2017), Geng <i>et al.</i> (2017), Li and Wu (2019), Zhang and Huang (2019), Pham <i>et al.</i> (2019), Wang <i>et al.</i> (2020a, b), Wang <i>et al.</i> (2021), Ettinger <i>et al.</i> (2021), Zhu <i>et al.</i> (2022), Tang <i>et al.</i> (2022), D'Arco <i>et al.</i> (2023), Ekelund and Bergquist (2023), Lee and Lee (2024), Zong and Fukushige (2024)
Moral disengagement	Wu <i>et al.</i> (2021b), Vespestad <i>et al.</i> (2023), Zhao <i>et al.</i> (2024)
Contingent valuation model	Rodríguez-Oromendía <i>et al.</i> (2013), McCreary <i>et al.</i> (2018), Jin <i>et al.</i> (2019), Zydrón <i>et al.</i> (2020), Martin Barroso <i>et al.</i> (2022), Hoang <i>et al.</i> (2022), Juutinen <i>et al.</i> (2022), Linnés <i>et al.</i> (2022), Panwanitdumrong and Chen (2022), Xu <i>et al.</i> (2023)
Source(s): Own elaboration	

engage in PEB (Nilsson and Küller, 2000; Han and Hyun, 2018; Wang *et al.*, 2020a, b; Ribeiro *et al.*, 2023). However, there are researchers who analyze these factors isolated without related with any theory (Han and Hyun, 2018; Wang *et al.*, 2020b).

For example, Wang *et al.* (2020a) examined the effects of intrinsic and extrinsic religiosity and environmental concern on tourists' pro-environmental behavioral intentions. In intrinsic religiosity, individuals engage in religion because of the internal goals of their religious tradition (Allport, 1966; Chang *et al.*, 2019). However, in extrinsic religiosity, individuals engage in religion to achieve their own goals (Allport, 1966; Raggiotto *et al.*, 2018). The results show that environmental concern and intrinsic religiosity had an effect on pro-environmental behavioral intentions. Han and Hyun (2018) proposed a general model in which they analyzed normative factors (moral norms, descriptive norms and injunctive norms), affective factors (anticipated pride and anticipated guilt) and habitual factors (water conservation and towel reuse in everyday life) on pro-environmental behavioral intention in the context of hotels (towel reuse and water conservation in hotel). The results show that all factors influence PEB intentions, with the exception of descriptive norms and injunctive norms in water conservation. Finally, other authors combine the different factors and theories to analyze tourists' PEB. For example, the results of the study by Onwezen *et al.* (2013) show that anticipated pride and guilt mediate the effects of personal norms (norm activation model) on PEB.

Table 2 shows how the literature has analyzed the different theories or factors that influence tourists' PEB. Additionally, we can observe the measurement of PEB through the methodology

Table 2 Main literature of PEB in tourism								
Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Onwezen et al. (2013)	"Western societies face increasing environmental problems, such as climate change and environmental, water and air pollution. Although it can be safely assumed that most people prefer to have a clean and healthy environment, there are temptations to act in environmentally unfriendly ways (e.g. wasting energy and littering). Because these environmental issues are associated with individual lifestyles."	NAM	-Affective factors	Quantitative: CB-SEM	-Awareness of consequences -Ascribed responsibility -Personal norm -Anticipated guilt -Anticipated pride -Environmentally – friendly buying behavior -Intention -Attitude -Social norms -Perceived behavioral control	NAM (Gärling et al., 2003, Bamberg et al., 2007) Anticipated pride and guilt (Kugler and Jones, 1992, Tracy and Robins, 2007) Environmentally – friendly buying behavior (Thøgersen and Ölander, 2003) TPB (Ajzen, 1991)	-Personal norms, social norms, and emotions affect the PEB	-Analyzing the relationship between personal norms and anticipated pride and guilt -The NAM variables would measure at a more specific level -Introduce a longitudinal, cross-lagged, and experimental research

(continued)

Table 2 Continued								
Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Han and Hyun (2018)	“There is a general consensus that the normative process, which includes moral and social norms, the emotional process, which includes anticipated pride and guilt, and the habitual process, which includes the frequency of environmentally friendly behavior in everyday life, are central concepts in explaining travelers’ environmental choices and behavior.”	–	-Normative factors -Affective factors -Habitual factors	Quantitative: CB-SEM	-Moral norm -Descriptive norm -Injunctive norm -Anticipated pride -Anticipated guilt -Water conservation behavior in everyday life -Towel reuse behavior in everyday life -Towel reuse intention at a hotel -Water conservation behavior in hotel	Not specified each construct (Ajzen, 1991, Bamberg <i>et al.</i> , 2007, Han, 2014, Han and Hwang, 2017a, b, Hwang and Hyun, 2017, Lyu and Hwang, 2017, Onwezen <i>et al.</i> , 2013, Perugini and Bagozzi, 2001, Smith <i>et al.</i> , 2012, Untaru <i>et al.</i> , 2016)	-Moral norm message and social norm factors in guest rooms can be a useful tool in inducing water and towels saving behavior -Anticipated pride and affect is an essential process to fortify guests’ intentions to conserve water and reuse towels	-Explore possible and effective ways in which sustainability programs can enhance the guest experience -Investigation of such green behavior at different service levels (i.e. luxury, upscale, midscale, and economy) and its drivers
(continued)								

Table 2 Continued

Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Han et al. (2018a, bc)	"Pro-environmental behavior describes an action by an individual or group that promotes or results in the sustainable use of natural resources"	NAM	-Normative factors	Quantitative: PLS-SEM	-Personal norms -Environmental awareness -Environmental responsibility -Social norms -Pro-environmental behavioral intention -Social media engagement	Personal norms (Vining and Ebreo, 1992 , Vandenbergh, 2005 , Harland et al., 2007 , Kiatkawsin and Han, 2017) Environmental awareness (Oreg and Katz-Gerro, 2006 , Kiatkawsin and Han, 2017) Environmental responsibility (Zhang et al., 2014 , Kiatkawsin and Han, 2017) Social norms (Rimal and Real, 2005 , Han, 2015 , Doran et al., 2017) Pro-environmental behavioral intention (Kiatkawsin and Han, 2017) Social media engagement (Lim et al., 2015 , Narangajavana et al., 2017)	-Tourists with more environmental awareness and social norms tend to have the intention to act pro-environmentally	-Analyze the way in which people can be made to have a pro-environmental behavior more effectively through messages in tourist information -Analyze the impact of social networks on pro-environmental behavior or intentions in tourism

(continued)

Table 2 Continued								
Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Liu <i>et al.</i> (2020)	“Pro-environmental behaviors can be defined as an act causing minimal damage to the environment, even beneficial to the environment.”	TPB	-Cognitive factors	Quantitative: CB-SEM	-Environmental knowledge -New Environmental Paradigm -Environmental Behavior Intention -Pro-environmental behaviors	Environmental knowledge (Dayong and Chenyang, 2007, Xiao and Hong, 2010) New Environmental Paradigm (Dunlap <i>et al.</i> , 2000) Environmental Behavior Intention (Bock <i>et al.</i> , 2005, Tabernero and Hernández, 2011) Pro-environmental behaviors (Xiao and Hong, 2010, Goldman <i>et al.</i> , 2006)	-Environmental knowledge has a significant positive impact on environmental attitudes -Attitudes towards the environment and pro-environmental behavior is a predictor of environmental behavioral intentions -Environmental attitudes play a central role in the transformation of environmental knowledge into behaviors	-Integrate environmental knowledge into a complete TPB model -The study measures general environmental knowledge, further research on specific environmental knowledge will supplement this research -Introduce a longitudinal or causal experiment research (continued)

Table 2 Continued

Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Wang <i>et al.</i> (2020b)	"Tourists' pro-environmental hotel behavior is voluntary, and it may be driven by conscious environmental concerns"	–	-Normative factors -Cognitive factors	Quantitative: CB-SEM	-Intrinsic religiosity -Extrinsic religiosity -Frugality consciousness -Connectedness to nature -Pro-environmental Behavioral Intention -Environmental concern	-Intrinsic religiosity and extrinsic religiosity (Bhuiyan <i>et al.</i> , 2018, Raggiotto <i>et al.</i> , 2018, Chang <i>et al.</i> , 2019) -Connectedness to nature (Gosling and Williams, 2010, Rezapouraghdam <i>et al.</i> , 2018) -Frugality consciousness (Roiland, 2016, Huang and Wang, 2018, Pan <i>et al.</i> , 2019) -Environmental concern (Felix <i>et al.</i> , 2018, Han <i>et al.</i> , 2018a, b, c, Verma <i>et al.</i> , 2019) -Pro-environmental Behavioral Intention (Wang <i>et al.</i> , 2018, Han and Hyun, 2018)	-Tourists with intrinsic religiosity are more likely to consciously follow their religion doctrine and voluntarily engage in pro-environmental hotel behaviors -Tourists with intrinsic religiosity are more likely to have high levels of frugality consciousness, and connectedness to nature -The positive effect of intrinsic religiosity on tourists' pro-environmental hotel behavior is strengthened as environmental concern increases	-Study PEB in different contexts because the article analyzed PEB in the context of hotels -Introduce new factors, such as empathy, habit, and emotion -Introduce a longitudinal experiment research

(continued)

Table 2 Continued

Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Wu <i>et al.</i> (2021b)	“PEB represents the behavior that minimizes the negative impacts of an individual's action on the environment or that even benefits the environment. There are a variety of activities that can be deemed as PEBs including recycling, picking up litter, conserving energy, and volunteering time to conservation projects.”	MD NAM	-Normative factors	Quantitative: CB-SEM	-Social influence -Moral obligation -Pro-environmental Behavioral Intention -Moral disengagement	-Social influence (Nolan <i>et al.</i> , 2008, Göckeritz <i>et al.</i> , 2010) -Moral obligation (Onwezen <i>et al.</i> , 2013) -Pro-environmental Behavioral Intention (Hughes <i>et al.</i> , 2011, Ramkissoon <i>et al.</i> , 2013a) -Moral disengagement (Bandura <i>et al.</i> , 1996, Moore <i>et al.</i> , 2012)	-When tourists perceive that other people rarely adopt conservation behaviors, people adopt the PEB to a lesser extent -When tourists perceive that other people adopt conservation behaviors, people adopt the PEB to a greater extent -The promoting and inhibiting effect of moral obligation and moral disengagement, respectively, are almost equivalent to each other -Tourist with a high level of moral obligation toward environmental conservation is more likely to have PEB	-Establish a comparison between nature-based tourists and mainstream tourists -Explore the antecedents of moral disengagement or other interventions between moral variables and sustainable behavior -Establish a comparison between different cultures with the objective of observing the cross-cultural variations -Introduce a longitudinal research

(continued)

Table 2 Continued

Source	Concept of PEB	Theory	Factors	Methodology	Scale	Measurement	Main results	Future research
Ribeiro <i>et al.</i> (2023)	"It is broadly defined as behaviors that not only limit negative impacts of an individual's actions on the natural environment, but also promote or result in sustainable natural resource use (e.g. recycling, litter pick-up, saving energy, and volunteering for conservation projects)"	GCVs	-Cognitive factors	Quantitative: PLS-SEM	-Altruistic value -Ascribed responsibility -Attitude to PEB -Biospheric value -Egoistic value -Environmental concern -Green consumption value -Pro-environmental travel behavior -Willingness to sacrifice	-Altruistic value; biospheric value; and egoistic value (Van Riper and Kyle, 2014; Megeirhi <i>et al.</i> , 2020) -Ascribed responsibility (De Groot and Steg, 2009; Landon <i>et al.</i> , 2018) -Environmental concerns (Cordano <i>et al.</i> , 2011; Han <i>et al.</i> , 2015) -Attitude to PEB (Ajzen, 1991; Ajzen and Fishbein, 1980; Han <i>et al.</i> , 2015) -Willingness to sacrifice (Davis <i>et al.</i> , 2011) -PEB (Han <i>et al.</i> , 2015)	-The Gen Z cohort's positive attitudes toward green travel practices and willingness to make sacrifices for the environment contribute significantly to their engagement in green travel behaviors -Gen Z tourists who highly value green consumption are more likely to have positive attitudes, express environmental concern and engage in green travel behavior -Values, ascribed responsibility, attitudes concerning the behavior, and willingness to sacrifice as determinants of PEB	-Establish a comparison between different cultures with the objective of observing the cross-cultural variations -Introduce new variables: environmental knowledge and big-five personality traits -Establish a comparison between different generational cohorts

Source(s): Own elaboration

and different scales that have been used in the literature. We have selected each publication on the basis of the most publication of each period. The articles following qualitative methodological approaches mostly conducted single survey data to collect cross-sectional data to analyze PEB in tourism (Onwezen *et al.*, 2013; Liu *et al.*, 2020; Wang *et al.*, 2020b; Wu *et al.*, 2021b). Accordingly, this method tends to collect data at a single point in time by asking tourism and hospitality consumers to report their feelings or perceptions (Lin *et al.*, 2022). This method is effective in identifying correlations between constructs. However, this method has several problems, such as testing theories or analyzing changes in patterns over time. In this sense, there are few studies which use experimental or longitudinal studies to reduce this common-method bias (He *et al.*, 2023).

3. Methodology

3.1 Bibliometric analysis

Bibliometric analysis is widely used by researchers to evaluate articles published in a particular scientific field (Ding and Yang, 2020). Bibliometrics uses a quantitative approach and allows a visual representation to be obtained of the bibliography of a field of study through scientific mapping in the form of authors, journals, words or documents (Boyack and Klavans, 2010). This analysis allowed us to present the state of the intellectual structure, emerging trends, and hot topics by providing a systematic and comprehensive knowledge of PEB in tourism (Zhang and Quoquab, 2022). Moreover, it is the ideal analysis when faced with a broad scope of review and a large data set (Donthu *et al.*, 2021). On the other hand, the scientific mapping was completed with the performance analysis, which is another aspect of bibliometric method, which allowed us to perform a descriptive analysis of the main publications, authors and institutions, which is the most used in all bibliometric studies in order to measure the productivity and effect in terms of the number of publications and citations (Donthu *et al.*, 2021; Gao *et al.*, 2021a). The VOSviewer program has been used to analyze the data obtained and to obtain visual networks (Fauzi, 2023). This program creates maps in relation to citation analysis, co-citation and co-occurrence of keywords (van Eck and Waltman, 2022; Pelit and Katircioglu, 2022). VOSviewer to facilitate pragmatic data analysis through its robust graphical interface. This interface enables the creation of maps that allows the building and visualization of hotspots, emerging trends, intelligent networks and the analysis of its evolution over time (Van Eck and Waltman, 2022; Gao *et al.*, 2021b). The Web of Science (WoS) Core Collection database was used to obtain the documents that will allow us to perform the bibliometric analysis. This database is chosen because it has been widely adopted in bibliometric analyses (e.g. Leung *et al.*, 2017; González-Serrano *et al.*, 2020; Pelit and Katircioglu, 2022 or Rojas-Lamorena *et al.*, 2022) due to its impact factor and its acceptance as the most recommended index available by the scientific academy (González-Serrano *et al.*, 2020; Fauzi, 2023). WOS is ideally suited for our research because of its reliability and trustworthiness in the complete citation network within a research domain, its longevity with over 100 years of scientific coverage, and its reach with over one billion cited reference connections (Kim and So, 2022; Zulfiqar *et al.*, 2024).

Citation analysis allows the identification of the most influential articles in a given scientific field by reflecting the intellectual links between publications that are formed when one publication cites another (Gundolf and Filser, 2013; Appio *et al.*, 2014). Co-citation analysis reveals the intellectual structure of a given research field (Rossetto *et al.*, 2018), the underlying themes (Liu *et al.*, 2022) and changes in the literature over time (Pelit and Katircioglu, 2022). This analysis performed in conjunction with the citation analysis, provides an overview of the most influential topics in the field of PEB research by tourists (Hota *et al.*, 2020). However, both analyses should be complemented by co-word analysis with the aim of assessing the current subject matter of the field of study (Zupic and Čater, 2015). Keyword co-occurrence analysis or co-word analysis is a scientific mapping technique that allows the exploration of the interaction of keywords in the sample publications (de la Hoz-Correa *et al.*, 2018). The main objective is to suggest the currently most prominent influential topics in the field of study of PEB by tourists. In addition, the analysis has been

completed with measurements of the relative contribution of the themes to the research field over the years from longitudinal analysis (López-Herrera *et al.*, 2012; Munoz-Leiva *et al.*, 2015; del Barrio-Garcia *et al.*, 2020).

3.2 Search string

Identifying the right keywords is a critical stage in the selection of articles (Paul and Criado, 2020). Firstly, according to Rodríguez-López *et al.* (2020), Molina-Collado *et al.* (2022) and Pelit and Katircioglu (2022), we analyze the articles with a higher number of citations in PEB in the WoS database, with the aim of analyzing which are the keywords with the greatest impact in this field of study (Budeanu, 2007; Goldstein *et al.*, 2008; Han *et al.*, 2010; Ballantyne *et al.*, 2011; Ramkissoon *et al.*, 2013a, b; Chen and Tung, 2014; Han, 2015; Miller *et al.*, 2015; Kim *et al.*, 2019; Tian and Robertson, 2019). In this case, it is interesting to note that *pro-environmental intention* and *PEB* are used interchangeably in the literature. This is due to the fact that, as Han *et al.* (2010) argue on the basis of the TPB (Ajzen, 1991), most human behaviors are predictable on the basis of intention because such behaviors are volitional and under the control of intention. Secondly, we selected the keywords found in the topic, (title, abstract or keywords, following the recommendations of Paul and Criado (2020), with the aim of analyzing the articles most closely related to the topic. On the basis of this precedent, we used the following search query in order to obtain the most relevant research papers related to the PEB of tourists. The keywords chosen and the search query used were (*pro-environmental intention* OR *pro-environmental behavior* OR *environmental responsibility behavior* OR *environmentally friendly behavior* OR *environmental protection behavior* OR *sustainable environmental behavior*) AND (*touris** OR *hospitality* OR *hotel* OR *restaurant* OR *travel*). It yielded a total of 2,534 documents.

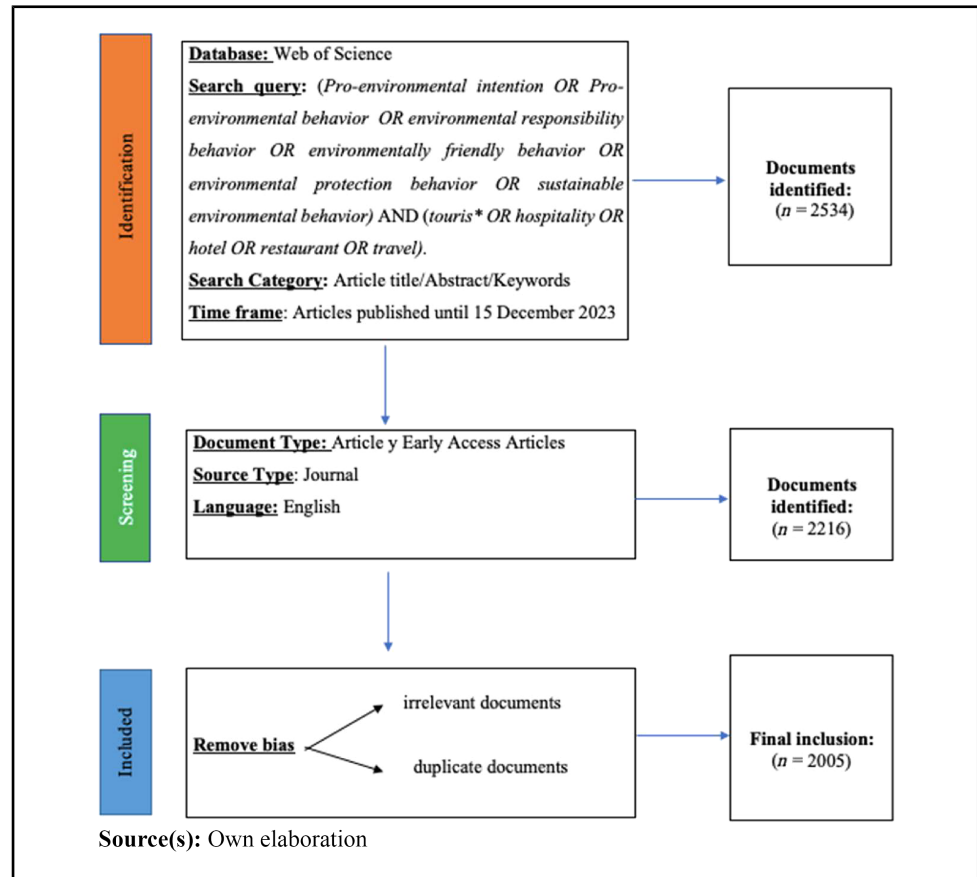
These documents were then reviewed in depth using the appropriate filters, following the recommendations of Liu *et al.* (2022), Bhukya and Paul (2023) and Shin *et al.* (2023). First, only English-language articles were included, excluding book chapters, review articles, editorial material, conference proceedings, books, etc. for the period between 1999 and 15 December 2023, coinciding with the first article relating the two concepts (Root and Schintler, 1999). Second, in order to remove any bias from the study, we carefully reviewed all articles and eliminated those studies that were not related to the topic analyzed. All members of the research team read the title, keywords and abstract of each article and assessed its relevance and appropriateness. Finally, we used Excel software to check for duplicate records. Consequently, applying these filters we obtained a sample of 2005 documents (Figure 1).

4. Results

4.1 Performance analysis

In our analysis, a total of 2005 articles were obtained from 403 journals as shown in Table 3. There is an upward trend in the number of publications over time, with a maximum production in 2023 of 342 publications and with a higher number of citations in 2010 with 5,407 citations (Figure 2).

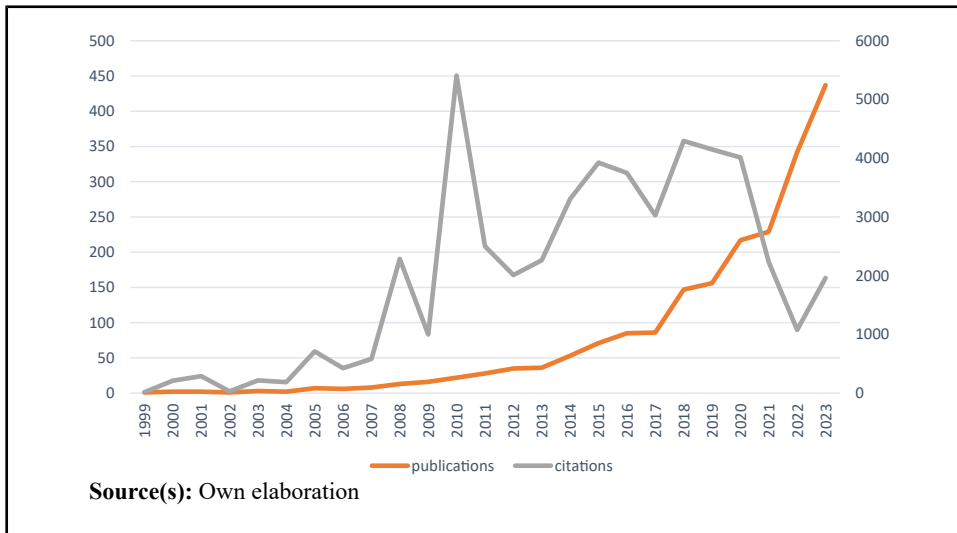
Table 4 shows the most productive authors in the field analyzed. Researchers from South Korea and Australia stand out in terms of scientific production and number of citations. Specifically, Heesup Han from Sejong University (South Korea) and Sara Dolnicar from the University of Queensland (Australia) are the authors with the highest number of citations and the highest number of publications. However, in relation to citations per article, Haywantee Ramkissoon of the University of South Australia (Australia) and Tsung Hung Lee of Yunlin University (Taiwan) stand out. Finally, eight of the authors have a successful scientific career (*h-index*>20). This complementary indicator is widely used with the aim of measuring the greater or lesser degree of success in the professional career of the authors (Hirsch, 2005; Díaz, 2014).

Figure 1 Data inclusion criteria**Table 3** Summary of data

<i>Web of Science</i>	<i>Record count</i>
Articles	2005
Keywords	4,677
Citations	48,371
Journals	403
Authors	4,333
Institutions	1725
Countries	96
Study time	1999–2023

Source(s): Own elaboration

Table 5 shows the most influential and productive institutions in the field analyzed. As with the authors, Australian and South Korean universities stand out for their scientific production. In terms of productivity by number of articles published, Sejong University (South Korea) and the University of Queensland (Australia) stand out. However, the institutions with the greatest influence in terms of citations per article are Dong-A University (South Korea) and Monash University (Australia). It is noteworthy that most of the universities are in a high position in the Scimago Institution Rank (SIR) in the ranking related to business, management and accounting, which indicates the thematic relevance of the field analyzed. In addition, the institutions have published in the last year, which indicates that the subject matter is current.

Figure 2 Number of publications and citations from 1999 to 2023**Table 4** Top ten authors by number of papers in the Web of Science data

Author/s	Papers	Cites	C/P	First paper	Last paper	University	h index (WoS)
Han, Heesup	56	4,679	83.55	2010	2023	University of Sejong (South Korea)	70
Dolnicar, Sara	26	1,509	58.04	2006	2023	University of Queensland (Australia)	56
Kim, Wansoo	17	635	37.35	2017	2022	University of Gachon (South Korea)	31
Ramkissoon, Haywantee	16	1,572	98.25	2012	2023	University of South Australia (Australia)	38
Morrison, Alastair	12	104	8.67	2018	2022	University of Greenwich (England)	37
Font, Xavier	10	600	60	2010	2021	University of Surrey (England)	39
Hyun, Sunghyup Sean	10	404	40.40	2020	2021	University of Hanyang (South Korea)	39
Wang, Shanyong	10	326	32.60	2018	2023	University of Science & Technology (China)	34
Lee, Tsung Hung	9	872	96.89	2011	2022	National Yunlin University Science & Technology (Taiwan)	23
Hwang, Jinsoo	9	503	55.89	2015	2022	University of Sejong (South Korea)	35

Note(s): C/P (average citation per paper); First Paper (year first published); Last Paper (year last published)
Source(s): Own elaboration

4.2 Citation analysis of pro-environmental travel behavior

In our analysis we present the citation analysis of documents with the objective of observing the most cited documents with the greatest influence in the field of PEB of tourists. In [Table 6](#) we present the 10 documents with the highest number of citations in the analyzed field of study. The documents have a high number of citations, indicating the relevance of the thematic field. The links refer to the relationship forged between the papers in the analyzed sample ([van Eck and Waltman, 2022](#)).

Table 5 Top ten institutions by papers in the Web of Science data

University	Country	Papers	Cites	C/P	First paper	Last paper	SIR (2023)
University of Sejong	South Korea	58	3,150	54.31	2006	2023	224
University of Queensland	Australia	39	1780	45.64	2011	2023	3
University Polytechnic of Hong Kong	China	33	919	27.89	2011	2023	1
University of Griffith	Australia	29	958	33.03	2010	2023	6
University of Dong A	South Korea	25	2,645	105.8	2010	2021	996
University of Surrey	Great Britain	24	681	28.37	2013	2022	70
University of Kyung Hee	South Korea	22	519	23.59	2012	2022	250
University of Johannesburg	South Africa	21	533	25.38	2015	2023	22
University of Sun Yat Sen	China	20	394	19.7	2013	2023	32
Monash University	Australia	19	1938	102	2009	2022	4

Note(s): C/P (average citation per paper); First Paper (year first published); Last Paper (year last published).
SIR (Scimago Institution Ranking)

Source(s): Own elaboration

Table 6 Top ten papers by cites in the Web of Science data

Paper	Cites	C/Y	Links	Type of study	Methodology
Ewing and Cervero (2010)	2,339	180	37	Quantitative	Meta-Analysis
Goldstein et al. (2008)	1,588	106	77	Quantitative	Descriptive-Statistics
Han et al. (2010)	944	73	183	Quantitative	Surveys (CB-SEM)
Chen and Tung (2014)	670	74	134	Quantitative	Surveys (CB-SEM)
Giles-Corti et al. (2016)	534	76	1	Qualitative	Descriptive-Analysis
Han (2015)	518	65	208	Quantitative	Surveys (CB-SEM)
Ramkissoon et al. (2013a)	443	44	89	Quantitative	Surveys (CB-SEM)
Gössling et al. (2012)	394	36	29	Qualitative	Descriptive-Analysis
Kim and Han (2010)	350	27	110	Quantitative	Surveys (CB-SEM)
Juvan and Dolnicar (2014)	344	38	111	Qualitative	Interviews

Note(s): C/Y (average citation per year)

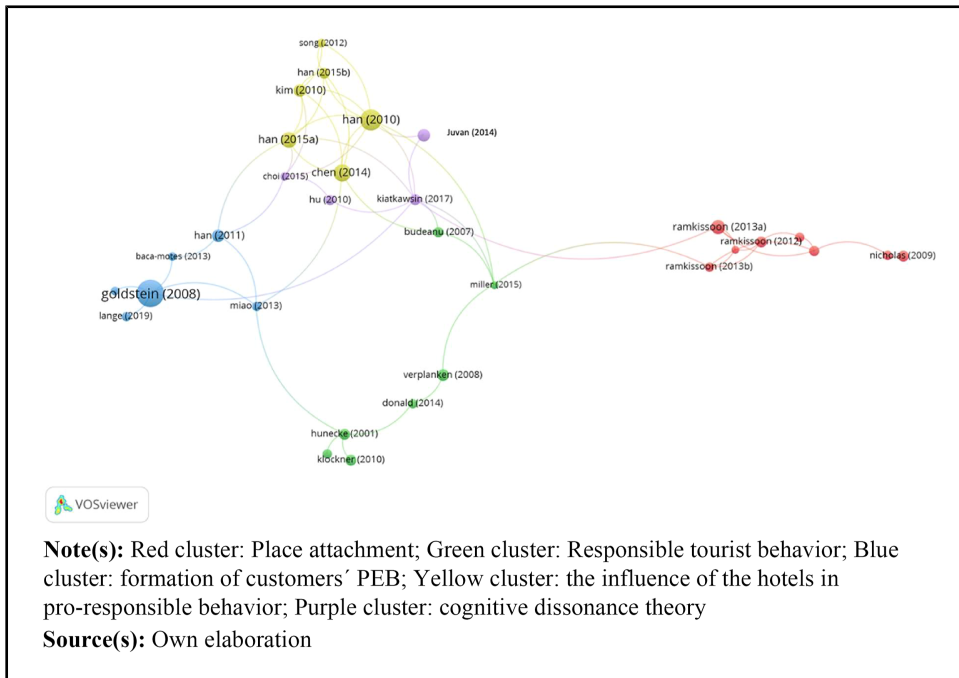
Source(s): Own elaboration

The most cited article is by [Ewing and Cervero \(2010\)](#), who analyzed the existing literature through a meta-analysis based on the articles that had investigated the impacts of travel on the environment. The results show that frequency of travel and length of stay are the most important factors to consider when analyzing the impact of travel in the literature. The second most cited article is by [Goldstein et al. \(2008\)](#) who analyze the impact of warning signs by hotels in relation to the sustainable behavior of tourists. The results show that descriptive messages explaining negative environmental effects have a greater impact than mandatory messages. The third most cited paper is [Han et al. \(2010\)](#), based on Ajzen's theory of planned behavior (TPB) model ([Ajzen, 1991](#)), with the aim of explaining how tourists' intention to visit a green hotel is formed. The results show that the model consists of three constructs: attitude; subjective norms and perceived behavioral control.

[Figure 3](#) shows how the citation analysis produces five clusters from the most representative publications.

Cluster 1 (red) is called "place attachment." Place attachment refers to the relationship that a person has with a tourist destination, based on the experiences that are forged with the place and

Figure 3 Citation networks (documents) in the Web of Science data



the emotional bond that is created (Hidalgo and Hernandez, 2001; Kyle *et al.*, 2003). Place attachment is composed of two components: place identity, which is a symbolic or affective attachment to a place; and place dependence, related to place functionality (Vaske and Kobrin, 2001; Lee, 2011). Numerous studies have addressed place attachment as an antecedent of tourism PEB (Lee, 2011; Ramkissoon *et al.*, 2012, 2013a, b; Lee & Jan, 2019) because the place attachment that tourists have about a destination causes them to engage in more environmentally responsible behaviors with the goal of its conservation (Kato, 2006).

Cluster 2 (green) is called “responsible tourist behavior.” This cluster focuses on analyzing the antecedents that make tourists behave responsibly while on vacation. Miller *et al.* (2015) argue that understanding the factors that affect PEB is a complex area because it affects prosocial and self-interest motivations. In this regard, the authors analyzed the antecedents that make a tourist have PEB in the context of TPB. The TPB is used by the author in order to analyze whether the attitude of responsible behavior translates into actual responsible holiday behavior. The results show that attitude is not a good predictor of sustainable holiday behavior because environmental attitudes can be very strong, but when exposed to greater challenges and difficulties in a tourism context, they are less likely to materialize in a real behavior.

Cluster 3 (blue) is called “formation of customers' PEB.” In this cluster, the authors analyze how different tourism service managers can promote PEB among tourists. First, Bergquist and Nilsson (2016) propose normative behavior theory (Cialdini *et al.*, 1990) as a theoretical framework to analyze the promotion of PEB among tourists. This theory proposes that normative influence can be enhanced by focusing people's attention on social norms. The results show that instructions written in a demanding (e.g. negative) manner (prescriptive norms) lead to lower compliance than less demanding instructions (proscriptive norms). Second, Han (2015) used the value-belief-norm theory and the theory of planned behavior to explain the formation of travelers' pro-environmental intentions in a green lodging context. Results indicate that customers with greater awareness of harmful outcomes, social pressure and moral norms were more likely to intend to choose an eco-friendly lodging property.

Cluster 4 (yellow) is called “the influence of the hotels in pro-responsible behavior.” In recent years, the detrimental impact of hotels on the environment has attracted the attention of tourists (Chen and Peng, 2012; Jones *et al.*, 2014). Therefore, those hotels, which are introducing measures that reduce damage to the environment and are becoming more eco-friendly (Han *et al.*, 2010; Jones *et al.*, 2014), are experiencing a higher demand. Consequently, numerous studies have shown how green and sustainable hotels develop and implement sustainability business strategies (Han *et al.*, 2010).

Cluster 5 (purple) is called “cognitive dissonance theory.” Tourists generally have a positive attitude towards the environment and do not wish to behave negatively toward it (Dolnicar, 2004; Wurzinger and Johansson, 2006). However, in the context of environmentally responsible behavior in tourism, having a positive attitude does not necessarily translate into making environmentally responsible choices while on vacation (Becken, 2004; Bergin-Seers and Mair, 2009). In this regard, the literature has identified possible reasons for finding the existing attitude–behavior gap in the context of environmentally responsible tourism (Hu *et al.*, 2010; Choi *et al.*, 2015; Juvan and Dolnicar, 2014; Kiatkawsin and Han, 2017). Juvan and Dolnicar (2014) used the TPB to analyze how positive attitudes in everyday life influence actual behavior. The results show, in the first place, that although tourists were generally concerned about environmental attitudes at home, they did not show such responsible behavior during the holiday, generally because they justified the holiday as an exception to relax and enjoy themselves. Second, tourists show a tension between enjoying a holiday and knowing that it has negative environmental consequences. To explain this tension, the authors used the cognitive dissonance theory (Festinger, 1957), which postulates that people experience psychological discomfort when there is an inconsistency between cognitions (attitudes, beliefs, values, opinions and knowledge) and their real behavior.

4.3 Co-citation analysis of pro-environmental travel behavior

The co-citation analysis of documents allows us to study the intellectual structure of our scientific field (Leung *et al.*, 2017). In Table 7 we highlight the documents with the highest number of citations and total link strength. Total link strength indicates the number of times a paper has been co-cited with other papers within the set of papers analyzed (van Eck and Waltman, 2022). The paper with the highest number of citations is Ajzen's (1991), which shows that an individual's behavioral intentions are composed of attitude toward the behavior, subjective norms and perceived behavioral control. This theory, called the theory of planned behavior (TPB), has been widely adopted in predictive studies on consumer intention and behavior (Linnes *et al.*, 2022). The second article with the highest number of citations is Fornell and Larcker (1981). This article is widely used to establish methodology in structural equation modeling with the aim of establishing cause–effect relationships in the context of tourists' PEB (Fakfare and Wattanacharoensil, 2023; Esfandiar *et al.*, 2020).

Table 7 Top ten documents in the co-citation analysis in the Web of Science data

Article	Citation	Total link strength	Type of study	Methodology
Ajzen (1991)	415	33,185	Qualitative	Descriptive analysis
Fornell and Larcker (1981)	315	27,736	Quantitative	SEM
Stern (2000)	244	20,611	Qualitative	Descriptive analysis
Han (2015)	203	17,369	Qualitative	CB-SEM
Steg and Vlek (2009)	195	16,397	Qualitative	Descriptive analysis
Han <i>et al.</i> (2010)	183	15,827	Qualitative	CB-SEM
Kollmuss and Agyeman (2002)	169	14,480	Qualitative	Descriptive analysis
Anderson and Gerbing (1988)	154	13,470	Qualitative	Descriptive analysis
Podsakoff <i>et al.</i> (2003)	152	13,661	Qualitative	Descriptive analysis
Chen and Tung (2014)	129	11,689	Qualitative	CB-SEM

Source(s): Own elaboration

Figure 4 shows how the co-citation analysis produces three clusters from the most representative publications.

We call the red cluster “antecedents of tourists’ pro-environmental behavior.” The studies are focused on analyzing what are the causes that produce sustainable behavior in tourists (place attachment, satisfaction, place dependence, place identity, place affect, residents’ support, community attachment, community involvement, among others). For example, [Ramkissoon et al. \(2013b\)](#) analyzed tourists visiting the Dandenong Ranges National Park (Australia). The results show that those who had higher place attachment and satisfaction with the tourist destination had more responsible environmental behavior with the destination. [Chiu et al. \(2014\)](#) analyzed tourists visiting the Sicao Ecological Area in Taijiang National Park (Taiwan). The results show that perceived value, tourists’ active participation and satisfaction positively influenced environmentally responsible intention.

The green cluster is called “Tourists’ behavior in relation to sustainability.” The studies are focused on analyzing how to encourage tourists to behave responsibly while on vacation. In the context of vacations, those tourists who have a positive environmental behavior in house do not translate this into actual vacation behavior ([Becken, 2004](#); [Bergin-Seers and Mair, 2009](#)). Therefore, [Juvan and Dolnicar \(2014\)](#) systematically identify the reasons why tourists do not behave in the same way both at home and on holiday as follows: denial of consequences; denial of responsibility; denial of control due to financial or time constraints or belief of damage compensation.

We call the blue cluster “The role of green hotels in the pro-environmental behavior of tourists.” A green hotel is defined as pro-environmental accommodations that implement different green practices, such as saving energy and water, reducing solid waste and recycling durable goods with the aim of protecting the environment ([Green Hotel Association, 2023](#)). The fundamental difference between green hotels and sustainable hotels lies in their scope and focus. While green hotels focus primarily on the implementation of environmental practices, sustainable hotels take a broader approach that encompasses aspects such as minimizing environmental impact,

Figure 4 Co-citation networks (references) in the Web of Science data

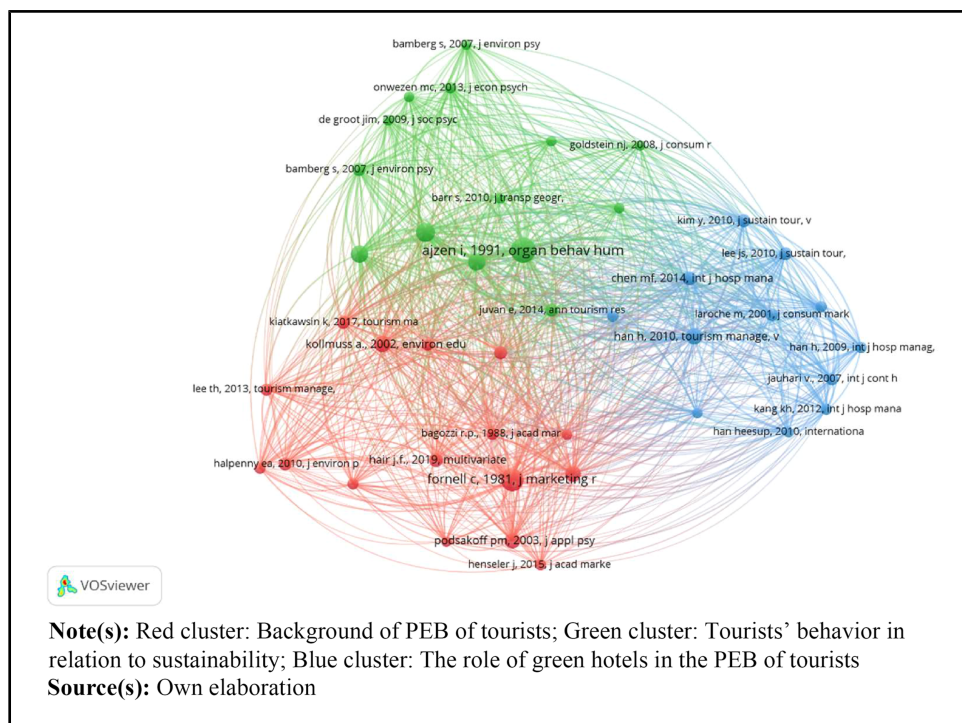


Table 8 Top 20 keywords in the [Web of Science \(2023\)](#) data

Rank	Keywords	Occurrences	Total link strength
1	Pro-environmental behavior	153	685
2	Sustainability	140	635
3	Sustainable tourism	137	653
4	Theory of planned behavior	93	403
5	Tourism	87	391
6	Ecotourism	63	263
7	Travel behavior	62	297
8	Climate change	61	283
9	Place attachment	53	234
10	Green hotels	51	228
11	Attitudes	49	253
12	Environmental attitudes	43	178
13	Environmental concern	39	179
14	Sustainable development	34	153
15	Environment	33	141
16	Environmentally responsible behavior	30	139
17	Environmental knowledge	28	133
18	Covid-19	27	139
19	Corporate social responsibility	26	107
20	Sustainable consumption	25	116

Source(s): Own elaboration

specific keywords appear together in the documents of the analyzed sample ([van Eck and Waltman, 2022](#)). As we observe, the words with the highest number of occurrences are “pro-environmental behavior,” “sustainability” and “sustainable tourism.” From a total of 4,677 keywords, we obtained 86 keywords from a minimum occurrence of 10.

We refer to Cluster 1 as “sustainable transportation.” In recent years, there has been a growing emphasis on the significance of transportation efficiency and the adoption of technological advancements to address climate change ([Davison et al., 2014](#)). However, it is crucial that tourists adopt a change of mindset when traveling, with the aim of achieving long-term changes ([Delclòs-Alió et al., 2022](#)).

We refer to Cluster 2 as “sustainable tourism.” Sustainable tourism is that type of tourism that acts in accordance with the prerogatives of the planet and local communities, by protecting cultural integrity, biodiversity and ecological processes and subsystems ([Hernández-Garrido et al., 2023](#)). In addition, this type of tourism is a niche market for tourist destinations because tourists demand greater environmental protection ([Abdullah et al., 2020](#)).

We refer to Cluster 3 as “green hotels.” Travelers show an increasing awareness of practices that may harm the environment, which has led hotels to implement measures related to environmental protection. These practices include the use of sustainable materials, reduction of water and energy consumption, and other sustainability-focused initiatives ([Yusoff et al., 2020](#); [Rehman et al., 2023](#)).

Cluster 4 we call “theory of planned behavior in the pro-environmental behavior of tourists.” In the context of tourism PEB, TPB is widely used because it analyzes whether pro-environmental behavioral intention (PEBI) is translated into actual behavior by tourists (PEB) ([Dolnicar et al., 2019](#)). Thus, numerous studies have used this theory as a conceptual and empirical basis ([Budovska et al., 2020](#); [Bai and Zhang et al., 2021](#); [Al-Khaldy et al., 2022](#); [Calder et al., 2022](#); [Linnes et al., 2022](#); [Aseri and Ansari, 2023](#)). We refer to Cluster 5 as “the effect of air travel on climate change.” Currently, air travel contributes approximately 4% of CO₂ emissions in the European Union. In addition, international travel accounts for 3.4% of these emissions, while domestic travel accounts for 0.4% ([European Environment Agency, 2022](#)). Moreover, this figure is

projected to continue to increase in the coming years (Alfaro and Chankov, 2022). Therefore, consumer behavior with its attitude toward air travel has been the subject of scientific debate. For example, numerous studies have concluded that there is a need to reduce the frequency of air travel or international travel (Gossling *et al.*, 2020; Becken *et al.*, 2021; Andersen, 2022). We refer to Cluster 6 as the “destination image in environmentally responsible destinations.” Destination image is defined as the set of attributes with which visitors associate a destination, as well as the perceptions and expectations they have about it (Crompton, 1979; Abdullah *et al.*, 2019). Tourists’ environmental image with a tourism destination is linked to tourists’ perceptions of environmentally sustainable practices, environmental conservation, environmental concerns or environmental commitments (Lee and Jeong, 2018). When destinations build the environment as a core element of their image, tourists engage in environmentally responsible behavior at the destination (Chiu *et al.*, 2014; Phau *et al.*, 2014; Abdullah *et al.*, 2019; Bilynets *et al.*, 2023). We refer to Cluster 7 as “sustainable development of tourism destinations.” Currently, the expansion of tourism has endangered the environment, culture, traditions and customs of local people in new tourism destinations. Therefore, it is crucial for tourism destination managers to establish effective policies and regulations with the aim of implementing initiatives that reduce the environmental impact in such destinations (Chong, 2020; Jamaliah *et al.*, 2021).

4.5 Longitudinal analysis

4.5.1 Current topics of pro-environmental travel behavior. In order to complete the content analysis, we performed a longitudinal analysis (Tables 9 and 10). The objective is to identify the most relevant topics based on the number of citations and the number of articles for each keyword. In addition, we identified the relative relevance of the keyword clusters from the research topics by mean year (López-Herrera *et al.*, 2012; Barrio-García *et al.*, 2020). The results show that the clusters *green hotels* (26.43), *destination image in environmentally responsible destinations* (32.43) and *theory of planned behavior in the PEB of tourists* (35.85) have the highest relevance in the total period (see Table 9).

4.5.2 Hot topics of pro-environmental travel behavior. A significant proportion of the research commenced in 2018, as a considerable number of investigations were initiated during that period (Figure 1 and Table 10). In order to enrich this analysis, it is necessary to compare the progress of this scientific analysis in two periods: 1999–2017 (Figure 6) and 2018–2023 (Figure 7). This is necessary to analyze the hot topics and emerging directions in PEB (Guan and Huang, 2022).

From Figures 6 and 7, we can see that there are new keywords that are important today. In Figure 6 we can observe that the previous research in PEB in tourism relies on “green hotels”; “sustainable development of tourism destinations”; “theory of planned behavior in the pro-environmental behavior of tourists”; “sustainable tourism” and “the effect of air travel on climate change.” However, in Figure 7, we can see the five new research topics that have appeared since 2018. Therefore, these topics need to be further discussed in PEB in tourism:

- (1) Factors and theories in PEB in tourism. As can be seen from the keywords “environmental awareness,” “environmental knowledge,” “personal norms” and “attitudes,” the factors and theories that have served as theoretical frameworks for analyzing PEB among tourists, have become more important in recent years. Firstly, there is the TPB, which has been used by researchers as an explanatory framework for how intention, influenced by attitude, is a perfect proxy for behavior (Ajzen, 1991). Another theory is the value-belief norm theory, which establishes a relationship between personal norms and behavior (Stern *et al.*, 1999). Therefore, future research could focus on further analysis of theories and factors that analyze the complexity that influences tourists’ PEB.
- (2) The influence of China in PEB. China has exceptional biodiversity and a unique historical heritage, being the second largest country in the world with the second highest number of World Heritage Sites in 2023 (UNESCO, 2023), receiving 145 million visitors annually in 2019

Table 9 Longitudinal analysis by keywords citations/paper

Keyword	Frequency*	Cites/Documents**	Average Year***
Travel behavior	62	25.91	2018.05
Environmental sustainability	23	17.72	2019.52
Sustainable mobility	22	9.47	2019.87
Sustainable transport	19	19.3	2018.01
Sustainable tourism	137	31.45	2017.8
Ecotourism	63	19.83	2017.35
Attitudes	49	31.34	2017.7
Environmental attitudes	43	23.1	2018
Sustainability	140	17.78	2019.2
Tourism	87	22.63	2018.42
Green hotels	51	78.94	2019.13
Covid-19	27	15.64	2021.65
Nature-based tourism	22	23.59	2018.74
Conservation	19	28.35	2018.71
Sustainable development	34	17.04	2018.36
Sustainable tourism Development	13	13.8	2018.33
Pro-environmental behavior	153	25.92	2020.07
Theory of planned behavior	93	52.13	2019.62
Environment	33	31.73	2018.93
Personal norms	22	19.96	2019.7
Environmental behavior	13	35.12	2019.23
Destination image	14	25.25	2019.81
Place attachment	53	45.19	2019.26
Satisfaction	19	37.83	2019.22
Climate change	61	26.093	2018.14
Sustainable consumption	25	36.57	2017.92
Willingness to pay	24	22	2018.88
Air travel	17	30.8	2018.1

Note(s): * Frequency: Number of times that a keyword appears in the database

**Cites/documents: For example, if a keyword appears in 3 papers with 12 cites, the average cites/documents would be 4

*** Average year: For example, if a keyword appears twice in 2020 and one time in 2022 the average year would be 2020.67

Source(s): Own elaboration

Table 10 Longitudinal analysis by cluster citations/paper

Keyword	Frequency	Cites/Documents	Average Year
Red network	126	18.1	2018.86
Green cluster	292	26.43	2017.71
Blue cluster	305	33.74	2019.60
Orange cluster	88	20.7	2018.53
Yellow cluster	301	32.43	2019.58
Light blue cluster	99	35.85	2019.38
Purple cluster	127	28.86	2018.26

Source(s): Own elaboration

(IGAPE, 2023). However, China is the country with the highest CO₂ emissions in 2022, with a total of 12,667,428 megatons (Datos Macro, 2022), putting this biodiversity at risk. Consequently, the decarbonization policy of the Asian country requires a change in the

Figure 6 Co-occurrence of authors keywords (1999–2017)

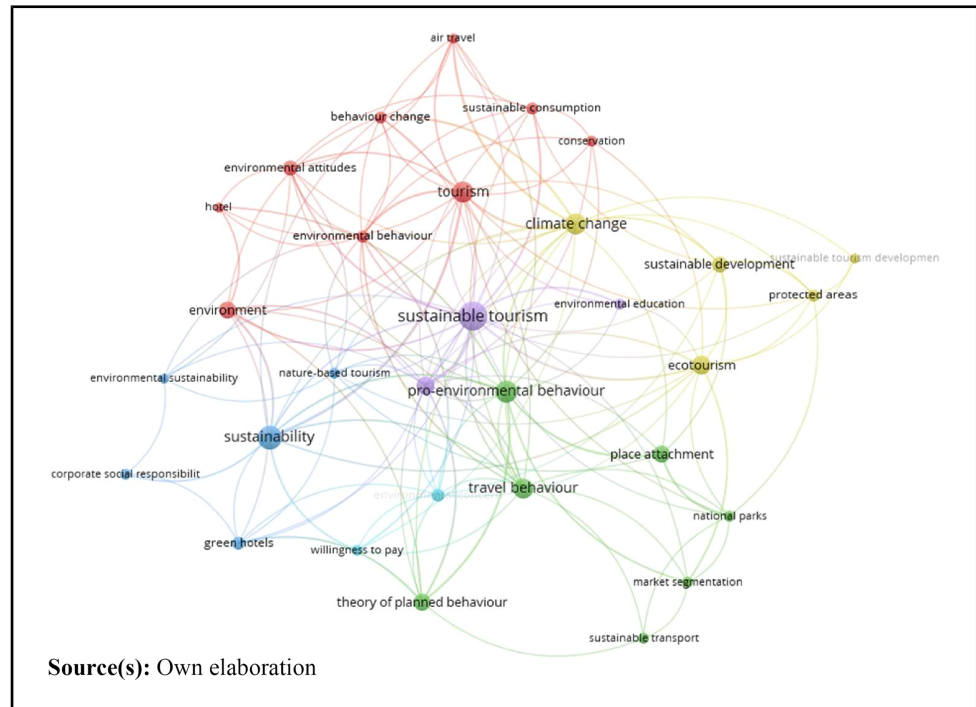
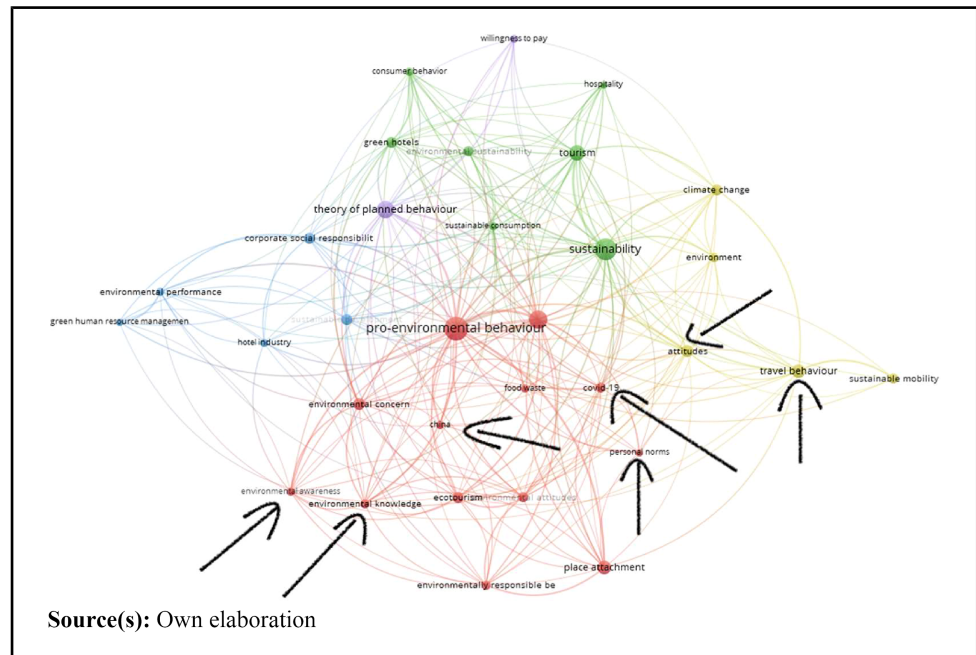


Figure 7 Co-occurrence of authors keywords (2018–2023)



tourism model due to the negative impact of tourism on environmental sustainability, with the aim of preserving this heritage and environmental legacy. In this context, the Asian country has introduced a number of measures to comply with the 2030 Agenda for Sustainable

Development, such as the launch of a green tourism database in 2016 to promote green tourism initiatives. Due to China's impact on environmental sustainability, numerous studies (He *et al.*, 2018; He and Filimonau, 2020; Bai and Zhang, 2021) have analyzed how policymakers and destination managers can cope with the rapid growth of tourism in China while respecting the prerogatives of sustainability. In this sense, future studies should analyze the importance of tourists' PEB in the Chinese context.

- (3) The impact of Covid-19 in PEB in tourism: Covid-19 is a new keyword that appeared in 2020 in the "Tourism, Hospitality and Leisure" category due to the emergence of the Covid-19 pandemic and its impact on the tourism industry caused by mobility restrictions (Abbas *et al.*, 2021). In addition, this pandemic has had behavioral and mental health effects (Lu *et al.*, 2021). Specifically, people have been rethinking the relationship between humanity and the environment, e.g. assessing the impact of their activities on the environment (Kapecki, 2020). In this regard, many authors have concluded that the pandemic has had a positive effect on tourists' PEB due to factors such as risk and environmental awareness (Hall *et al.*, 2020). For example, the results of the study by O'Connor and Assaker (2021) showed that tourists had higher PEB in the context of the pandemic, based on the economic sacrifice theory, which states that tourists are mostly willing to pay a higher price or make economic sacrifices for the sake of the environment. In this sense, future studies should analyze whether the environmental impact of the pandemic is sustainable in the long run or whether it is only temporary.
- (4) Sustainable mobility in tourism. Sustainable transport is one of the most important elements to promoting PEB among tourists, such as the use of electric, public or zero-emission vehicles. There are two challenges that the tourism industry has to face in terms of sustainability: on the one hand, the difference between the behavior of tourists at home and on holiday, with less consideration given to less environmentally friendly choices on holiday; and on the other, the high use of car and air travel on holiday, which are the two least sustainable modes of transport from a global perspective. In this sense, the results of the study by Isetti *et al.* (2020) and Zamparini and Vergori (2021) show that the solution lies both in increasing tourists' knowledge of the impact of unsustainable transport on climate change and the destination managers and policymakers promoting the creation of infrastructure and public transport services to encourage environmentally conscious behavior. Therefore, future studies should analyze how to improve the sustainable behavior of tourists in tourist destinations.

5. Discussion

5.1 Theoretical implications

In contrast to the other bibliometric studies on the topic under study (Lu *et al.*, 2021; Farrukh *et al.*, 2023; Zhang and Quoquab, 2022; Goyal and Goyal, 2024), this study is more comprehensive and exhaustive in the identification of the actual knowledge (citation analysis), theoretical underpinnings (co-citation analysis) and future research directions (co-word analysis) of PEB in tourists. For instance, the content analysis reveals lines of PEB research that do not appear in these previous studies, namely: "sustainable transport"; "sustainable tourism"; "theory of planned behavior in the pro-environmental behavior of tourists"; "the impact of air travel on climate change" and "destination image in eco-destinations." Moreover, this article provides a detailed analysis of the future lines of investigation through the longitudinal analysis. The longitudinal analysis shows that future investigation in PEB rely on the factors and theories that make a tourist behave responsibly toward the environment, and especially the importance of TPB; the influence of China in PEB through their new policy of sustainability in their country; the effects of Covid-19 on PEB and the sustainability mobility in tourism. Finally, this article integrates theories and factors that previous studies have used to analyze PEB in tourism but that these articles have not analyzed. In this regard, the literature review fills gaps in the previous literature in terms of theories

(theory of planned behavior, green consumer values, norm activation model, value-belief norm, expectancy theory of motivation and moral disengagement) and factors (normative factors, cognitive factors, affective factors and habitual factors).

The theoretical framework of this scientific field shows that the study of PEB is complex due to several factors that influence the behavior of tourists. In this regard, we present the factors and theories that scholars have used to study PEB in tourism and different scales and tools (Tables 1 and 2). The description of the state of PEB in tourist's research (O1) shows a growing academic interest in this field of study, with scientific output tripling between 2017 and 2023 (Figure 2). Geographically, Australia and South Korea stand out as they contain the most productive authors and institutions (Tables 4 and 5). The identification of the most influential articles on PEB of tourists through the citation analysis (O2) shows the most cited publications rely on the topics *place attachment*; *responsible tourist behavior*; *formation of customers' PEB*; *the influence of hotels in pro-responsible behavior*; *cognitive dissonance theory* (Table 6 and Figure 3). The identification of the theoretical underpinnings of the academic literature on the PEB of tourists (O3) shows that the documents that have mainly contributed to the intellectual structure over time rely on *background on PEB of tourists*; *tourist's behaviors in relation to sustainability*; and *the role of green hotels in the PEB of tourists* (Table 7 and Figure 4). The identification of current lines and future research opportunities in the PEB of tourists (O4) shows that this is a complex, dynamic and diverse topic. The longitudinal analysis shows the actual relevance of research related to the topic of *green hotels*, the *destination image of environmentally responsible destinations* and the *theory of planned behavior in the PEB of tourists* (Figure 5). In addition, the hot topics and emerging directions in PEB (Figure 6) are based on the *factors and theories in PEB in tourism*; *the influence of China in PEB*; *the impact of Covid-19 in the PEB in tourism*; *sustainable mobility in tourism*; and *green hotels*.

5.2 Practical implications

The practical implications of the present bibliometric analysis can benefit tourism and hospitality practitioners and policymakers in several ways. First, the results show that travelers have an increased awareness of the negative impact of travel on the environment. Therefore, managers of tourism destinations should establish policies with the aim of reducing the environmental impact on these destinations and increasing demand (Chong, 2020; Jamaliah *et al.*, 2021). For example, due to the new demand for green hotels and environmentally responsible hotels, it is necessary for new hotels to implement sustainable measures such as the use of sustainable materials, reduction of water and energy consumption, and other sustainability-focused initiatives (Yusoff *et al.*, 2020; Rehman *et al.*, 2023). Second, the results of this study also show that place attachment is an antecedent of tourists' environmentally responsible behaviors. When tourists have a strong attachment to a particular destination or place, their commitment to the protection or conservation of that place is higher. Therefore, managers of tourism destinations should actively promote a sense of belonging to foster the relationship with visitors (Ramkissoon *et al.*, 2013a). For example, Ramkissoon *et al.* (2013a), who show a positive relationship between place attachment and tourism PEB in the context of a natural park, recommend that to increase place attachment, tourism managers should provide information (e.g. leaflets, information desks, tour guides, websites) and enable park users to contribute to the well-being and protection of the park's environment. Third, the results show that destination image plays a fundamental role in tourists' PEB. For example, the results of the study by Wu *et al.* (2021a) show that the managers of the Dinghu Mountain National Nature Reserve (China), which represents a globally unique ecosystem of tropical and subtropical forests, have made remarkable efforts to present an environmentally responsible destination image. This has been achieved through environmental education and interpretation programs that raise awareness of wildlife and environmental conservation (Hehir *et al.*, 2021). It is therefore imperative that destination managers present a responsible destination image in order to improve tourism PEB. Moreover, the local government plays a fundamental role in providing necessary green infrastructure (e.g. recycling bins),

especially for communities with inadequate environmental/green facilities. Finally, the results of the study of [Bergquist and Nilsson \(2016\)](#) and the normative behavior theory ([Cialdini et al., 1990](#)) show that proscriptive norms cause a higher effect in tourists than prescriptive norms. Therefore, destination managers should introduce proscriptive norms in their service tourists in order to enhance the PEB among tourists (for example, *don't leave the lights on*).

6. Agenda for future research

This bibliometric analysis shows that there is a need for further research on PEB in tourist destinations, as tourists play a fundamental role in the conservation of the tourist destination.

6.1 PEB and tourist destination competitiveness

The results of our article show how the competitiveness of traditional destinations is progressively decreasing, while the competitiveness of environmentally responsible destinations is increasing. Future research should analyze how tourism companies can improve their competitiveness by approaching environmental sustainability. First, we note that there is a lack of research on the influence of tourists' PEB on the local population of the destination ([Schüßler et al., 2019](#)). Tourist overcrowding and gentrification have threatened the sustainability of traditional tourist destinations and, ultimately, it negatively compromises the competitiveness of the tourist destination. Today, this problem is growing exponentially and can be observed in heritage destinations (e.g. Venice), coastal destinations (e.g. Bali) and mountain tourism (e.g. Everest). Because of this overcrowding, the destination risks exceeding its growth limits and eroding its carrying capacity through resource depletion and environmental degradation ([Mai and Smith, 2018](#)). However, we found a lack of research analyzing how the PEB can mitigate the effect of tourism overcrowding and gentrification. For example, future research would analyze how different norms can enhance the PEB of tourists and avoid the tourism overcrowding (for example, green taxes or tourist tax) ([Vena-Oya et al., 2024](#)).

Second, as discussed above, there is a relationship between the place attachment of a destination and PEB. TPB suggests that an individual's attachment to a particular place enhances the image of a destination and ultimately the PEB of tourists ([Ajzen, 1991](#); [Lin et al., 2022](#)). Therefore, how tourists and hospitality consumers react to and feel about a particular place can increase their willingness to act sustainably ([Lin et al., 2022](#); [Han, 2021](#)). In this regard, [Koningam et al. \(2024\)](#) point out that future studies analyze what type of intervention is more appropriate to influence in the place attachment of tourists, for example [Ramkissoon et al. \(2013a\)](#) point out that this can be done by provision of information (e.g. leaflets, information desk, tour guides and websites).

6.2 PEB and tourist experience

In our article, we have observed how the adaptation of tourism companies to new social demands based on sustainability improves the competitiveness of the tourist destination. However, future research is needed to analyze which are the factors on which these tourism companies should focus in order to improve the tourist experience and, in addition, that these tourists have an environmentally responsible behavior. First, the results of [Wu et al.'s \(2021b\)](#) study show a negative relationship between PEB and MD. Therefore, people with higher levels of MD are able to justify their behavior without suffering from guilt and distress and are more likely to engage in unethical behavior ([Bandura et al., 1996](#)). However, the authors explain that there is a gap in the analysis of the conditions under which MD is likely to occur. Future research should examine the antecedents of MD or other moral factors and their relationship to PEB.

Second, there are several studies that establish a relationship between intention and behavior based on the theory of planned behavior. However, intentions are sometimes found to be poor predictors of behavior, for example, when they depend in part on factors beyond the individual's

control (Ajzen, 2011). In this sense, Wang and Li (2022) recommend that future studies analyze the factors that induce the formation of purchase intention and actual behavior. On the other hand, past behavior has a strong correlation with later behavior (Ajzen, 2011). Past behavior could be understood “as actions or reactions of a person in response to external or internal stimuli in the past” (Sommer, 2011, p. 96). Therefore, some researchers argued that TPB could be improved by incorporating past behavior into the model (Han et al., 2010). Blandford et al. (2023) and Gidaković et al. (2024) recommend that further investigation of the TPB model is needed by including past behavior to predict behavioral intention. Finally, Shen et al. (2024) recommend that TPB and other related theories, such as the theory of protection motivation and the theory of reasoned action, could be integrated into a full model. This is useful to include social-psychological variables, such as environmental concern, perceived effectiveness, health risk perceptions and emotions.

Third, the implementation of sustainable policies in hotels differs between different types of hotels. Han et al. (2010) point out that there is a lack of research on the formation of PEB in relation to luxury or upscale hotels. On the other hand, Wu et al. (2021b) and Ribeiro et al. (2023) indicate that it would be interesting to establish a comparison between different cultures of study. In addition, the results of the study by Rehman et al. (2023) suggest that future studies should establish a comparison between developed and emerging countries.

Finally, there is a lack of research analyzing the sociodemographic and cultural characteristics of PEB in tourists. For example, although the results of the study by Ribeiro et al. (2023), have interesting results in relation to comparing the PEB formation of generation Z tourists, there is a lack of research in relation to establishing a comparison between different age generations. This would be justified by the fact that each generation has different characteristics, values and beliefs, along with preferred skills, qualities, abilities, interests, expectations and habits that can be directly attributed to them (Benckendorff et al., 2010). In this sense, Generation X is more pragmatic and influenced by the traditional values, Generation Y is more individualistic and seeks a balance between pragmatism and idealism and Generation Z is more focused on common causes (Casalegno et al., 2022). Therefore, in order to see the behavior between different age generations (X, Y and Z), future studies should analyze the formation of PEB between different age generations in order to observe whether they have differences in behavior due to their age. In addition, regarding the findings of Onel and Mukherjee (2016), O'Connor and Assaker (2021) Casalegno et al. (2022) or Chen et al. (2024), scholars point out that it would be necessary to conduct future research for different consumer segments (income levels, professional backgrounds, individualistic and collectivistic cultures or nationalities) to provide a more comprehensive understanding of PEB formation in tourism.

6.3 PEB and methodology

We encourage academics to consider new methods and techniques for data collection and analysis. In general, we believe that the integration of more sophisticated methodologies will facilitate the development of new research avenues, which are currently constrained by methodological constraints. First, Onwezen et al. (2013), Liu et al. (2020), Wang et al. (2020b) and Wu et al. (2021b) recommend that future studies would use an experimental or longitudinal research instead of a single survey data. The survey has an endogenous issue because surveys use cross-sectional data. Instead longitudinal studies variables are measured repeatedly over time, leading to clustered and correlated observations and causal conclusions (Lin et al., 2022; Hu & Szymczak, 2023). Experimental study allow control extraneous effects and testing theories (Viglia and Dolnicar, 2020; Lin et al., 2022). Therefore, future studies analyzing PEB in the context of tourism should use longitudinal or experimental studies, for example, to compare changes in behavior over time, to analyze patterns or provide new theories.

Second, Wu et al. (2021a) point out that most studies use linear behavioral models to analyze tourists' PEB, such as social norms, personal norms, values or infrastructure availability.

However, these models do not emphasize changing practices to make them more sustainable, as they only identify consumers' personal characteristics as antecedents to determine their intention to behave sustainably (Nilsson *et al.*, 2017). Therefore, the authors recommend that future studies use social practice theory, which is based on studying people's actions and behaviors rather than their internal mental processes. It emphasizes the routine actions, material elements, bodily actions and meanings in a social context (Galvin, 2017).

Third, the data collection methods could also be used to enhance more established research techniques. To reduce extraneous variance and increase internal validity, future studies should collect data from different countries through a more homogeneous sample (O'Connor and Assaker, 2021). This is in contrast to the current studies, which generally analyze the sample in one or two countries (Han *et al.*, 2010; Onwezen *et al.*, 2013; Ribeiro *et al.*, 2023).

Fourth, Bergquist and Nilsson (2016) and Al-Nafjan *et al.* (2023) recommend that future studies should use neuromarketing devices (e.g. eye-tracking, brain-computer interface or galvanic skin response) to analyze the sustainable behavior of tourists. This system is a novel methodological tool for analyzing consumer perceptions, as it has several advantages over traditional methods (e.g. questionnaires) because it can provide an objective and nuanced measure of where and how consumers' attention is focused in real time and it has an impact on gathering accurate emotional assessments for tourists (Chen *et al.*, 2024).

Finally, adopting a combination of several methodologies, such as cross-cultural variations (Wu *et al.*, 2021b), cohorts groups (Ribeiro *et al.*, 2023), different places of sampling (Wang *et al.*, 2020b), in-depth interviews, focus groups, participatory observations or ethnography (O'Connor and Assaker, 2021) could reflect the true nature of customer PEB.

7. Conclusion and limitations

In recent years, the rapid expansion of tourism has had a negative effect on the environment (Dolnicar *et al.*, 2019). Proof of this is that between 2009 and 2013, tourism has been responsible for 8% of total greenhouse emissions (Lenzen *et al.*, 2018). Thus, a major challenge for the tourism industry is to inspire responsible behavior among tourists (Turaga *et al.*, 2010). Studies about PEB date back to the last 40 years, in which numerous researches around the fields of sociology, psychology, business and marketing have analyzed the interactions between humans and the environment. From these studies, different authors have explored the factors that influence responsible behavior on the part of tourists, as their understanding is more effective in triggering behavioral change (Han, 2021).

Using VOSviewer, this study provides a holistic and comprehensive knowledge mapping of PEB for scholars. This study not only helps scholars to understand the definition of PEB, citation network, co-citation network, thematic clusters and emerging trends, but also visually displays the knowledge for the interested researchers. It will help scholars to see the research status of the past, including the most influential research and will enable them to have a general understanding of the future research trend. The results also suggest that researchers need to analyze more deeply the theories and factors behind the research on PEB in tourism. Furthermore, this study can help interested scholars to improve their research efficiency and investigate the emerging directions on PEB. Throughout its history, PEB in tourism research has grown in scope and depth, contributing to its current profile. Furthermore, the increase in the number of articles from 2018 to 2023 suggests that PEB is becoming increasingly popular in academia, due to the growing attention paid to the environment and the rapid increase in the number of environmentally conscious tourists.

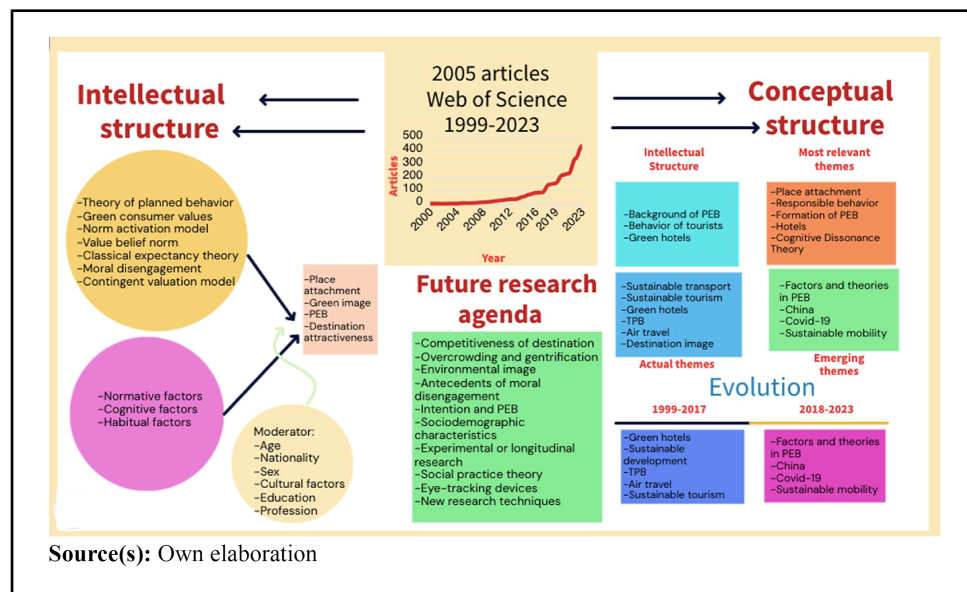
The main objective of this article is to visualize the structure and trends of PEB of tourists between 1999 and December 2023, which will help researchers, policymakers and destination marketing organizations (DMOs) to better understand existing studies and future research topics. The use of VOSviewer is a novel tool for analyzing the scientific literature, as opposed to traditional methods

of analysis, and allows the graphic visualization of key topics and the establishment of future challenges in the field of tourist PEB. In addition, it has been completed through longitudinal analysis in order to identify the topics with the greatest impact and those topics that have a greater tendency to grow. Results show that topics such as green hotels, sustainable development of tourism destinations, theory of planned behavior in the PEB of tourists, sustainable tourism and the effect of air travel on climate change were explored in the first thematic period from 1999 to 2017. Topics such as factors and theories in PEB in tourism, China, Covid-19 and sustainable mobility were included in the final thematic period in 2023.

Figure 8 summarizes the main contributions of this paper:

Finally, like every study, this one has its limitations. First, the sample was limited to publications in WoS, and it may be that relevant studies in this field are not included. As a result, there is a significant lack of non-English literature. New studies should include works in another database to include Spanish-language journals, among others (for example, Google Scholar or Scielo). This can be useful to compare the results obtained and to explore new concepts and new research trends related to PEB in tourists. Second, although it is common practice in bibliometric studies to use a single database to avoid duplication, new studies could include several databases in order to enrich the sample. Third, new bibliometric software like SciMAT or Bibliometrix could be used in the future to enrich this analysis. Third, our study uses the number of citations and publications as indicators of impact in the content and descriptive analysis. However, these indicators do not show an exact correspondence between the quality of publications and their academic interest (Gómez-Caridad and Bordons, 1996; Aksnes *et al.*, 2019). This could be due to a lack of synchronization, because more recent publications over time have less probability of showing their academic impact. Finally, in relation to the bibliometric approach to evaluate articles published in a particular scientific field, the academia shows that this methodology has strengths and limitations. The results of the study of Donthu *et al.* (2021) show that the main advantage of bibliometric analysis is to rely on the potential that have to analyze the social and structural relationships between different research constituents (e.g. authors, countries, institutions, topics). Although, this approach is recommended when the scope of review is broad, like our article, future studies could complete this analysis with the meta-analysis. This can be useful because this analysis summarizes the empirical evidence of the relationship between variables, while uncovering relationships not examined in existing studies.

Figure 8 Main contributions of the current manuscript



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