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Exploring research on water-saving measures applied to the hotel sector. A critical systematic review

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ABSTRACT

Climate change and tourist development are increasing the frequency and severity of water stress situations. This study aims to summarize the research findings in articles exploring water-saving measures applied in hotels. Based on the Cochrane protocol, a systematic review was conducted for the period 2000–2020. Several searches were run to select 39 articles and a coding system was built to classify the findings. Results point out that low cost are the most widely applied measures, probably because have shorter payback periods. However, reclaimed water is one of the most explored measures by academic literature. Different research gaps have been identified. First, no articles have explored the impact of the introduction of water-saving actions on hotels' competitiveness. Secondly, there is a lack of deeper exploration of stakeholders' roles and contributions to water-saving management. Finally, it would also be important to analyse to what extent new forms in hotel management influence decision-making.

1. Introduction

Sustainable water management constitutes an essential issue to socioenvironmental development, especially in regions where water is a scarce natural resource and highly disputed by multiple end-users (Gössling et al., 2012). Furthermore, the droughts induced by climate change, demographic pressure, and population water consumption behaviour will lead to huge water management challenges. Given the absolute relevance of water as a basic resource for productive and non-productive uses, social conflicts between end-users are expected to increase during periods of water stress. In this sense, relevant reports in the field estimate that more than 2 billion people live in highly water-stressed countries, and this figure is expected to grow shortly (Caretta et al., 2022). In addition, the effects of climate change will probably spread the water stress problem to countries that have not previously experienced it (Lehmann, 2019). The alteration in the dynamics of rainfall has caused drought and flood situations to become more frequent, increasing the problems of water storage and water availability (Hadjikakou et al., 2013; Liu et al., 2017).

Tourism is known to be a large water consumer (Cole, 2012), with severe environmental and social impacts on natural resources. In fact, the effects on water resources linked to tourist activities have been identified. In that sense, tourism affects the overall availability of freshwaters and increases the level of pollution and contamination of aquatic and marine ecosystems (Stonich, 1998). This fact is even more relevant if we consider the exponential growth observed in the tourism sector during the last decades. According to the World Tourism Organization, tourism international arrivals have grown from 436 million tourists in 1999–1466 million in 2019 (236.2% increment), representing 6.9% of the World Balance of Payments (UNWTO, 2022). This significant rapid growth has directly increased in water stress situations. Thus, the awareness of the necessity of saving water and the search for maximum efficiency in water use and consumption must therefore become a key issue in designing the strategies of tourist destinations.

One of the largest water consumers not only among the different tourist lodging options, as stated by Hamele and Eckardt (2006) but also within the entire tourism industry (Gössling et al., 2012), is the hotel sector. Despite the different determinants related to the size, star rating, or specific water services, some studies estimate that, on average, water consumption in hotels ranges from 216 litres per guest night (hereinafter L/g.n.) to 920, with an average of 686 L/g.n., according to a study compiling data from 30 published articles from different geographical contexts (Alhudaithi et al., 2022). It is important to note that these figures are significantly higher compared with the global average of

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160 L per capita and day of domestic water use estimated by Gössling et al. (2012). Additionally, it is important to point out that, despite the increase in new accommodation options (i.e., rental properties), hotels still constitute the most popular lodging option for tourists (UNWTO, 2022). Thus, the collaboration and cooperation of the hotel sector is indeed a key issue in achieving higher sustainable water management in tourism destinations. The impact of this sector on water resources can be partially mitigated by achieving the highest levels of water-saving efficiency, considering restructuring, and even reducing hotel services that consume water intensively. The hotel sector is aware of this and has developed numerous strategies to ensure tourists' water needs without compromising the environment (Gabarda-Mallorquí et al., 2020). Several measures to save water have been extensively applied to reach maximum efficiency in water use and consumption (Styles et al., 2015), understood as those mechanisms, devices, or tools aimed at reducing the pressure over water resources by reducing water consumption and/or by additionally using other non-conventional resources such as rainwater or reclaimed water. However, while it is true that the industry must be an active change-maker in saving water, other stakeholders need to be included in the promotion, management, regulation and boosting of any effort to reduce water consumption. As pointed out by Cole (2012), owners, local organizations and public administrators, among so many others, need to be considered to build a proper partnership to deal with the climate-based adaption process. From a Tourism-based political ecology approach proposed by Stonich (1998), tourism activities need to be understood as an integrated system in which several social actors play an important role in reducing water consumption and transitioning to sustainable development.

During the last decade, a significant number of academic papers have explored the measures applied to save water in hotels in tourist destinations dealing with water scarcity. Since water-saving strategies are covered by a wide range of disciplines, articles have been published in journals from various fields including environmental studies, geography, and leisure and tourism studies. Due to this multidisciplinarity, research on water-saving actions needs a common scheme that allows the main findings to be systemised and facilitates the transfer of scientific knowledge to hotel practitioners and policymakers through a concise summary of the state of the art. Thus, a systematic review must be conducted to analyse the water-saving measures applied in the hotel sector. Two previous literature reviews were published by Warren and Becken (2017) and by Antonova, Ruiz-Rosa and Mendoza-Jiménez (2021). The former is aimed at exploring water and energy-saving actions applied in the lodging industry from 1987 to 2015 including 110 peer-reviewed articles. The authors pointed out that energy is much more explored and that "more research is required to identify savings opportunities for water" (Warren and Becken, 2017, p. 298). On the other hand, Antonova et al. (2021) reviewed meticulously water use and consumption in the hotel industry between 2000 and 2019. The authors reviewed 58 articles, of which six were focused on the study of water-saving actions applied to hotels.

In that sense, this review is intended to update, firstly, Warren and Becken's study, focusing only on hotels and water-saving measures. It must be noted that hotels are usually the most frequent option chosen by tourists and constitute the most important lodging offer at many tourist destinations. Thus, the impact of the introduction of water-saving measures at hotels will be significantly higher compared with other lodging options. Moreover, hotel water management practices differ from other types of tourist accommodations, so obtaining reliable data on the amount of saved water in establishments other than hotels is challenging. In addition to the fact that the literature focused on water-saving measures is less frequent than that focused on energy savings, both resources (water and energy) are substantially different in terms of property rights, market structure, prices, and scarcity of the resource itself, which highly affect the analysis of the predictors explaining the implementation of water-saving actions, the effects in carrying them out, and the stakeholders who are directly implied in the implementation and management processes. Moreover, the launching of the United Nations Sustainable Development Goals in 2015 has resulted in the production of academic articles providing solutions and/or analysing actions to save water in the tourism sector.

Secondly, having in mind that the study published by Antonova et al. (2021) meticulously reviews water use and consumption in the hotel industry, the authors state that six articles from 58 were focused on good practices in water management, such as "the implementation of eco-initiatives related to water, water-saving measures, etc., in hotels" (*ibid*, p. 636). This review is intended to complement and extend the work of Antonova et al. and update the excellent research performed by the authors, by focusing specifically on water-saving practices in hotels. Thus, this study aims to provide a more detailed analysis of the explored measures focusing also on the predictors that could explain their implementation and the effects related to it, and the stakeholders involved in water saving as the study objects.

All in all, this review aims **to build the state of the art on the water-saving actions carried out in the hotel sector that have been the research object in academic articles published between 2000 and 2020.** Moreover, this review is intended to **establish the "who", "how", "when" and "where" of selected papers.** Four research questions were formulated based on this goal:

1. Which water-saving practices, applied to the hotel sector, have been explored within academia?
2. What are the main research findings related to the implementation of water-saving actions?
3. Which are the stakeholders identified as key actors involved in water-saving measures implementation and management?
4. What are the main gaps to be potentially filled by research from any scientific field?

The results of the paper are structured according to the four mentioned research gaps and provided in order to fill them.

2. Methodology

For this study, the systematic literature review methodology was chosen over other options such as narrative, bibliometric, or meta-analysis approaches. This decision was based on the advantages highlighted by Antonova et al. (2021) who suggest that a systematic review of literature is best when the research topic is fragmented. Additionally, Donthu et al. (2021) point out that this methodology is the most appropriate for a specific review scope with a small database that can be manually reviewed. This is in line with the study's goal and the number of records identified. To be more specific, this study has been conducted through a metasummary-based approach since it aims to extract and describe the main findings of selected papers by coding segments as summarized thematic statements (Y. Xiao and Watson, 2019).

The methods used in this review are linked to the Cochrane protocol which covers every explicit step taken to guarantee scientific rigour, transferability, and replicability (Boaz et al., 2002). According to Pahlevan-Sharif et al. (2019), the importance of following this type of protocol is essential to minimize possible interpretation biases and to produce reliable (and less subjective) evaluations of the body of knowledge. They also point out that the protocol can be used by tourism scholars since it represents one of the most complete checklists to assess current and future trends in any field. In their systematic review of systematic reviews in tourism, only five revisions (of 192 reviews) followed this protocol (Pahlevan-Sharif et al., 2019). The authors of this review have worked closely together to ensure accuracy and high quality in every step of the process proposed by Xiao and Watson (2019). They have carefully designed criteria, selected articles, and extracted data to minimize errors. Each author's specific background has helped to prevent misunderstandings in terminology and ensure proper treatment of key concepts. During the first review stage, the authors manually

reviewed the abstracts of identified papers without any software support. Their broad experience in the academic field of tourism and water management has greatly reduced the likelihood of misunderstandings.

2.1. Eligibility criteria and information sources

The key components of this study, according to the Population-Intervention-Comparison-Outcome approach (Thomas et al., 2021), were hotels as the main Population; water-saving measures as the principal Intervention; and a summary of the scientific approaches and main gaps in the literature as the Outcome. This review did not focus on any Comparison exercise. Papers published between 01/01/2000 and 31/12/2020 were analysed. The choice of the last two decades is because research on saving water processes in the tourism sector has increased since 2015, probably due to the launching of the United Nations' Sustainable Development Goals. The authors of this review were able to verify how the literature focused on water-saving measures in hotels was quite recent. Moreover, it should be noted that water stress situations are challenging tourist destinations. During the 21st century, climate change effects (Liu et al., 2017), the increasing population (World Bank Group, 2021), the hypermobility in tourism and the growing number of visitors (Gössling et al., 2012) among others, have resulted in recurrent and severe periods of water scarcity (United Nations World Water Assessment Programme, 2018). The concern among academics related to this issue has steadily materialized in an increasing number of publications aimed at providing solutions and advancing knowledge in the field.

The type of academic source to be included in this review was defined as published journal articles, excluding books, book chapters, proceedings, or any other source. Journal articles are known to be considered accessible and validated knowledge (Vrontis et al., 2021). The search process was conducted using two extensive databases widely accepted by the scientific community (Pranckutė, 2021), and which have already been used in other similar reviews (Antonova et al., 2021): Elsevier's Scopus and Clarivate Analytics' Web of Science (hereinafter WoS). As for the language, it is known that English is perceived as the universal language in science (Morrison et al., 2012). In that sense, English was the only language included in the search of this review since the exclusion of non-English-language papers tends to not affect the conclusions of systematic reviews (Nussbaumer-Streit et al., 2020). Although the paper's abstract and keywords were included in English, which is a usual practice (Antonova et al., 2021), non-English-language manuscripts were automatically excluded from this review.

2.2. Search strategy and data items

Three main conceptual constructs structured the targeted search parameters: (1) water as a resource, (2) processes to reduce water consumption, such as *saving*, *conservation* and *reduction*, and (3) the hotel sector, with words such as *hotel*, *tourist*, *accommodation*, *lodging*, *hospitality* and *guest*. These three components formed the variables according to which data were sought and selected (Table 1). Taking the main keywords, potential word formations were proposed to build the final search strings: *water, sav*, conservat*, reduc*, hotel*, tourist*, accommodat*, lodg*, hospitality*, and *guest**.

Once keywords and word formations were defined, the search process was executed through two main steps. Since the first step consisted of looking for matches in the abstract-based field and the second step looked for the string broadly in the topic-based field, several searching combinations were tested according to strategies 1–6 specified in

Table 2
Searching strategies conducted in Scopus and WoS databases.

Strategy	Database	1st step string	1st step results	2nd step string	Global results *
#1	Scopus	water AND (sav* OR conservat* OR reduc*) AND (hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)	961	-	961
#2	Scopus	water AND (sav* OR conservat* OR reduc*)	524,410	(hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)	2098
#3	**Scopus**	**water AND (hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)**	**7371**	**(sav* OR conservat* OR reduc*)**	**2336**
#4	WoS	water AND (sav* OR conservat* OR reduc*) AND (hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)	961	-	961
#5	WoS	water AND (sav* OR conservat* OR reduc*)	420,602	(hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)	1141
#6	**WoS**	**water AND (hotel* OR hospitality OR (tourist* AND (accommodat*) OR (lodg*)) OR guest*)**	**7228**	**(sav* OR conservat* OR reduc*)**	**1199**

* The search was run on 22nd December 2021.

Table 1
Main conceptual constructs, potential word formations and search strings used.

Concepts	Potential word formations			Searching form
water	water			**water**
saving	saving	save	saved	**sav***
conservation	conservation	conservative	conservating	**conservat***
reduction	reduction	reduce	reduced	**reduc***
hotel	hotel	hotels		**hotel***
tourist	tourist	touristic	tourists	**tourist***
accommodation	accommodation	accommodate	accommodating	**accommodat***
lodging	lodging	lodge		**lodg***
hospitality	hospitality			**hospitality**
guest	guest	guests		**guest***

Table 2. After running the six search strategies, numbers #3 and #6 were the most convenient since they covered the highest number of articles. Strategies #3 and #6 allowed the search to be restricted to tourism-based studies in the first step and to be further constrained by the water-saving-based concepts in the second step. The search of the Scopus database was executed using the "Article Title, Abstract, Keywords" field in the first step and the "Within the text" field in the second. The search of WoS was based on entering a search string into the "Abstract" field in the first step and the "Topic" field in the second.

The number of papers selected in this phase was 3535 (2336 in Scopus and 1199 in WoS). After searching through both databases, it was necessary to detect and remove duplicates. The total number of articles selected after the removal of duplicates was 2829 (2336 articles from Scopus as the primary database and 493 new references from WoS). Fig. 1 shows the process used to search, screen, and select full texts.

2.3. Selection and data collection processes

After the two-step search had been conducted, validation tasks had to be completed to ensure that the selected articles were appropriate for inclusion. The parameters by which articles were excluded were based on the following criteria: (1) articles focusing on Tourist Destinations in a broader sense (n=42); (2) articles focusing on Other Tourist Accommodations (n=11); (3) guest-centred articles exploring Guest Environmental Behaviour (n=35); (4) hotel-based articles focusing mainly on Water Quality (n=191); (5) tourism-based articles analysing water consumption reduction but through General Environmental Schemes (n=185); (6) articles exploring Water Use and Consumption in hotels (n=32); (7) Non-Tourism based articles (n=52); (8) articles selected as a result of a Pure Word Coincidence (n=2237); and (9) Systematic Reviews (n=2). Criteria "Pure Word Coincidence" needs further explanation since the number of records excluded is noteworthy. Since the logic sequences, used to search potential articles to be included in this review, include words related to "water" and "guests", the query returns papers mostly linked to academic fields such as chemistry or medicine, among others. In this sense, the word guest refers to concepts related to host-guest molecular elements. As for the last criteria, it's important to note that reviews, such as those published by Warren and Becken (2017) and Antonova et al. (2021), were not included as they don't specifically analyse water-saving measures implemented in hotels *per se*. Instead, as secondary literature sources, they only provide summaries of findings from previous studies.

The exclusion of articles was executed by accurately analysing their abstracts and applying the previously mentioned eligibility criteria. The authors reviewed 2829 abstracts. Through an initial discussion internal meeting, the research team analysed the results of the first-round review and classified the articles. The final number of records included in this review was 42. These articles were gathered from official sources. In cases where the authors' university databases did not have full access to a journal, interlibrary loans were taken from other national universities. If the article still could not be accessed, the authors of the selected article were contacted directly and asked for the required manuscript. A second review round was conducted by the team through in-depth reading of the full texts of the selected articles. Nine articles were removed from this review at this stage because they did not fit the purpose of this study (n=1), were not academic articles (n=1) or were not written in English (n=7), although the abstracts were written in English and so included during the screening stage, a recurrent fact when articles are submitted to journals (Antonova et al., 2021). Finally, 33 full texts were included in the qualitative analysis.

2.4. Developing the coding system

The full texts of 33 articles were analysed through a process of inductive approximation in which the authors built a code system using MaxQDA© software. Since the authors are familiar with the scientific literature in this field, the code system was created using a paraphrasing tool to identify relevant ideas and paragraphs (Gizzi and Rädiker, 2021). During the first attempt to code the text, a complex hierarchical code classification was created from the paraphrased texts. To ensure consistency and effectiveness in analysing data, the code system was reorganised into more concise groups by joining and reorganising sub-codes. Ultimately, the three top-level codes were (1) water-saving measures, (2) research findings, and (3) stakeholders mentioned and/or analysed (Table 3). The first code was used to identify the water-saving measures, actions and/or strategies analysed by the articles. The second code was created to explore the findings of each article. The third code identified the stakeholders that were directly involved in each study or mentioned as essential actors in the management, promotion and/or

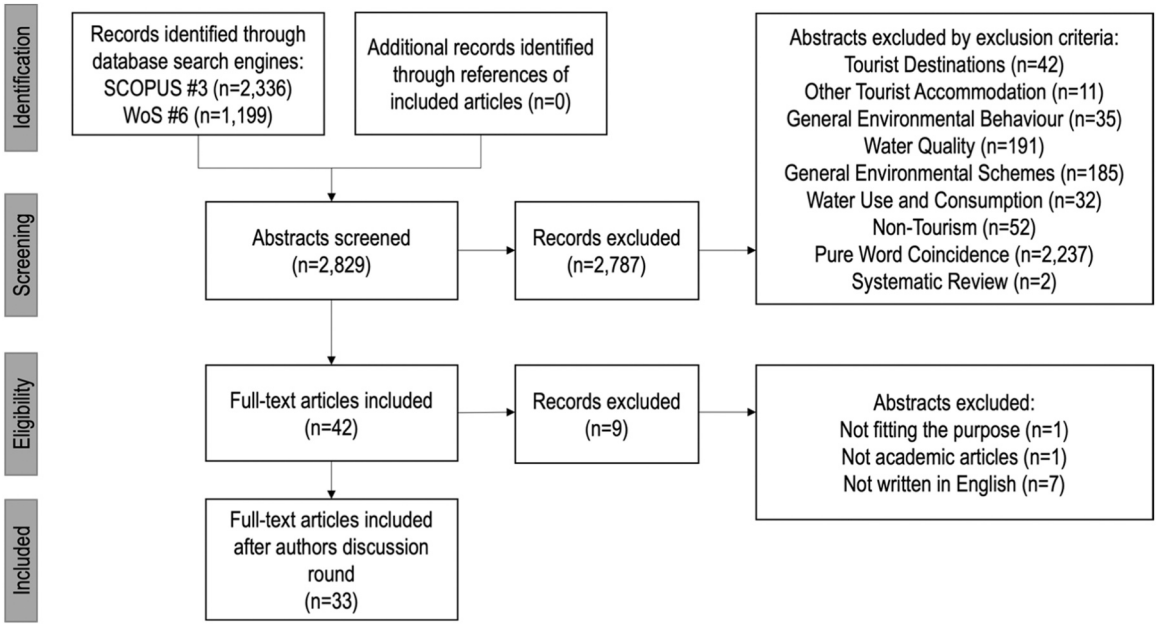


Fig. 1. The flow chart. *Authors' source, adapted from* Moher et al# (2009).

Table 3
The three top-level codes system.

Water-saving measures	*Research findings*	*Stakeholders*
Use of non-conventional water resources	**Water-saving measures implementation predictors**	**Hotel sector**
Rainwater harvesting	Business strategical factors	Pilot hotels
Use of recycled/ reclaimed water	Environmental awareness factors	Hotel competition
In-room devices	Legal factors	Hotel managers
Use of dual flush toilets and/or limited filling systems	Technical factors	**Public administration**
Replacement of regular taps and/or shower heads with water-saving devices	Socio-cultural factors	**Other services**
Replacement of bathtubs with shower bases	Infrastructural factors	Supply-licensed companies
Water-efficient awareness	Economic factors	Environmental consultancy services
Signs encouraging guests to use less water	**Water-saving measures implementation effects**	
Water-saving training to employees	Normative compliance	
General water management	Economic/ financial analysis	
Leakage control	Environmental impacts quantification	
Pressure reduction of the main hotel's water supply	Water-saving efficiency assessment	
Replacement of linen not daily		
Detailed control consumption through submeters		
Water prices, taxation and/or licenses		
Water-efficient machinery[a]		
Replacement of washing machines with water-efficient programs		
Replacement of HVAC with water-efficient devices		
Coffee machines with water recirculation system		
Actions applied in green zones		
Irrigation with water-efficient technologies		
Gardens with low water-requirement vegetation		
Replacement of green zones with pavements		
Actions applied in pools		
Pool filling with sea water		
Pool water-efficient filtering and cleaning		
Pool covering to avoid evaporation		
Unspecific water-saving measure and/or general overview		

[a] The three subcodes include the following actions: replacement of washing machines and/or dishwashers for "Replacement of washing machines with water-efficient programs"; replacement of Heating, Ventilating and Air Conditioning systems with water-efficient programs for "Replacement of HVAC with water-efficient devices"; and coffee machines with water-efficient mechanisms for "Coffee machines with water recirculation system".

implementation of the water-saving measure(s) analysed. It should be noted that several segments within a sole paper could be coded as belonging to the same category. The number of documents given in related figures in the results section could thus be higher than the number of articles included in this review (33).

A categorical matrix was also created which included five quantitative variables for each paper, namely (1) the author's scientific discipline, (2) the journal's field, (3) the research methodology used, (4) the publishing year, and (5) the case study (by country). The UNESCO nomenclature for fields of science and technology was used to classify the author's scientific profile and the journal's field for each article, allowing both items to be unified. Research methodology here refers to the main methodological process conducted in each article, defined as quantitative, qualitative and/or mixed methods. Concerning variable (5), it should be noted that an article can explore one or more case studies.

3. Results

3.1. Categorical analysis overview

To establish a clear picture of the topic, a brief quantitative description is presented below, considering the authorship, the method, the case study, and the journal field and publishing year. in the Appendix will help the reader to better understand the figures presented in this section.

3.2. About the authorship

A total of 88 researchers (104 authors are referenced since 12 of them contributed to more than one paper) participated in the reviewed papers. According to the UNESCO nomenclature, 38 of the authors had a technological background (corresponding to the category *2.7 Environmental engineering* from the UNESCO classification), 27 had an economic sciences background (*5.2 Economics and Business*), and 14 had a geography-linked background (*5.7 Social geography*). Regarding the rest, six of them worked in the architectural field (*6.4 Architectural design*), two in chemistry (*1.4 Chemical Sciences*) and one in agricultural sciences (*4.1 Agricultural, Forestry and Fisheries*). Most authors were affiliated with universities (73), although some represented research centres (8), private for-profit entities (6), and public non-profit entities (1).

3.3. About the research method

Most of the articles used quantitative methods (75.7%), while the rest were based on qualitative and/or mixed methodological techniques (12.1% and 12.1% respectively). Quantitative approaches are thus the methods most frequently used to explore water-saving measures in the hotel sector. The quantitative approach is based on positivism and aims to measure and analyse variables to represent the truth (Sale et al., 2002). This is the main purpose of articles aiming to test new water-saving technologies (Atanasova et al., 2017; Chai et al., 2013; Gattringer et al., 2016), calculate water savings (Abdallah and Al Antary, 2020; Klontza et al., 2016), or estimate economic savings (Gatt and Schranz, 2015; Styles et al., 2015). Conversely, qualitative research attempts to elucidate reality's complexity by employing an interpretative approach. From the qualitative point of view, there are multiple truths because reality is a social construct. This is the case in selected articles exploring the motivations and/or obstacles to implementing water-saving measures (Alonso, 2008), the experience of drought (Brandão et al., 2018; Dinarès and Saurí, 2015) or the perception of risk

(ElShafei, 2020) as predictors which explain the implementation of water-saving measures.

3.4. About the case study

About the "where" of the selected articles, most selected articles focused on Spain (12 documents, 36.3%), followed by Australia, Brazil, Egypt, Greece, Hong Kong, Malaysia, and Turkey (two documents for each). Thus, Spain was the location of the highest number of case studies discussed. Spain is a well-known Mediterranean tourist destination, and its water resources are under high pressure, especially along the Mediterranean coast and on the Canary Islands. This has undoubtedly led to the extended and in-depth research conducted by Spanish universities and research centres aiming to shed new light on the field of water-saving in the tourism sector.

3.5. About the journal field and the publishing year

According to UNESCO definitions, a major proportion of the articles were published in journals covering technological sciences (48.4%) and economic sciences (39.3%). Other journals relevant to this topic covered disciplines such as geography (9%), and medical sciences (3%). The earliest selected articles were published in 2008, despite this review searching for papers published from 2000 onwards. However, 79% of the papers were published between 2013 and 2020. During this period, two years seem to have been the most prolific: nine selected papers were published in 2016 and 2019 (five and four papers respectively).

3.6. Water-saving measures

To respond to the first research question, (RQ1) Which water-saving practices, applied to the hotel sector, have been explored within academia?, water-saving measures were classified into seven sub-codes according to where they were implemented and/or their nature, and an extra sub-code was used to identify those articles which aimed to explore water-saving measures through a general overview (Table 4). As mentioned previously, several sub-codes could be identified within the same article.

By observing the number of different documents in each of the general groups, most papers explore measures related to the use of non-conventional water resources (mentioned in 17 different articles), general water management actions (in 13 articles), and in-room mechanisms and devices aimed at reducing water consumption in hotel bathrooms (in 12 articles). The measures less mentioned included those applied to gardens and green zones (seven articles), water-efficiency awareness measures (six articles), water-efficient machinery replacement (six articles), actions placed in swimming pools (five articles), and unspecific water-saving measures and/or general overviews (six articles). The use of reclaimed water was the action that appeared most frequently in the selected documents (15 articles) followed by the replacement of regular taps and/or shower heads with water-saving devices (12 articles) and the use of dual-flush toilets and/or limited filling systems (10 articles). On the other hand, the less-mentioned water-saving actions included the use of coffee machines with water recirculation systems, the installation of shower bases to replace bathtubs, the replacement of HVAC with water-efficient devices, the replacement of green zones with pavements, and the pool covering to avoid evaporation (mentioned in one document each).

3.7. About the main research findings of selected articles

To respond to the second research question (RQ2), the second top-level code was related to the findings of each article when analysing one or more water-saving actions. Considering that a water-saving action is the research object, two main issues can be explored. The first is regarding the motivations (or the lack of) behind water-saving actions implementation from decision-makers, in this case, hotel managers or people in charge. This approach means exploring which factors can explain the reasons behind the implementation of water-saving actions, so compile the *ex-ante* elements understood as predictors. These *ex-ante* factors have been classified into seven groups: (1) business strategical factors, including motivations linked to the improvement of the company's green image; (2) environmental awareness factors, or those elements regarding the desire to minimize environmental impacts or linked to the environmental consciousness of the hotel decision-maker; (3) legal factors, meaning that water-saving actions have been applied to comply with regulations; (4) technical factors, including factors in regard to the technical capacity and knowledge to apply water-saving actions; (5) socio-cultural factors, when water-stress experience or the perception of potential drought periods are analysed as potential predictors; (6) infrastructural factors when elements related to hotel building characteristics (size, location) have potentially facilitated the

Table 4
Number of documents exploring each water-saving measure.

	Number of documents	Reference number
1. Use of non-conventional water resources	**17***	
Rainwater harvesting	5	1, 6, 19, 20, 28
Use of recycled/reclaimed water	15	4, 6, 8, 10, 11, 13, 14, 20, 22, 23, 24, 26, 28, 29, 31
2. In-room devices	**12***	
Use of dual flush toilets and/or limited filling systems	10	6, 7, 17, 19, 20, 21, 28, 29, 30, 33,
Replacement of regular taps and/or shower heads with water-saving devices	12	6, 7, 12, 14, 17, 19, 20, 21, 28, 29, 30, 33
Replacement of bathtubs with shower bases	1	19
3. Water-efficient awareness	**6***	
Signs encouraging guests to use less water	6	6, 17, 19, 28, 30, 33
Water-saving training to employees	3	17, 19, 28
4. General water management	**13***	
Leakage control	5	6, 19, 20, 29, 30
Pressure reduction of the main hotel's water supply	2	20, 17
Replacement of linen not daily	4	6, 17, 19, 30
Detailed control consumption through submeters	5	12, 14, 19, 20, 30
Water prices, taxation and/or licenses	5	15, 16, 27, 32, 33
5. Water-efficient machinery	**6***	
Replacement of washing machines with water-efficient programs	6	6, 17, 19, 20, 30, 33
Replacement of HVAC with water-efficient devices	1	30
Coffee machines with water recirculation system	1	17
6. Actions applied in green zones	**7***	
Irrigation with water-efficient technologies	6	6, 17, 19, 20, 29, 33
Gardens with low water-requirement vegetation	4	19, 20, 29, 33
Replacement of green zones with pavements	1	28
7. Actions applied in pools	**5***	
Pool filling with sea water	2	6, 19
Pool water-efficient filtering and cleaning	3	17, 28, 30
Pool covering to avoid evaporation	1	19
8. Unspecific water-saving measure and/or general overview	**6**	2, 3, 5, 9, 18, 25

* Number of different documents, not the sum of documents in each group item.

implementation of water-saving measures; and (7) economic factors, mainly when a water-saving action have been applied due to cost reduction willingness.

Secondly, a water-saving action can be analysed to elucidate the main effects of applying it. Thus, the consequences of implementing a measure, as *ex-post* elements, have been grouped into four typologies: (1) normative compliance, when after testing a water-saving action authors explored if water quality meets normative standards (this is fundamentally linked to the production of reclaimed water); (2) economic/financial analysis, when the cost savings or the payback period of implementing a measure is quantified; (3) environmental impacts identification, including those papers trying to quantify the environmental impacts in applying water-saving actions; and (4) water-saving efficiency assessment, when the papers are trying to elucidate the potential water volume saved. Bearing this in mind, 11 sub-codes (according to the seven *ex-ante* and four *ex-post* elements previously mentioned) have been created. It should be noted that more than one sub-code could be identified in the same article (Table 5).

The two items most explored were the testing of water-saving efficiency (*ex-post*), mentioned in 21 documents, and infrastructural factors (*ex-ante*), mentioned in 11 documents. By contrast, the less-explored items were those relating to environmental impacts as a proven effect when one or more water-saving actions were applied (mentioned in one document). This fact points out that elucidating which infrastructural factors allow the implementation of water-saving actions have attract the attention of researchers. In this sense, infrastructural characteristics can be considered one of the first hurdle to address. Similarly, the same can be applied when *ex-post* elements are considered. Water-saving efficiency assessment factor is the most explored implementation effect in articles explored. Trying to shed new light on the volume of water saved once a measure has been applied, research has paid attention in determining the potentiality of water-saving actions. Thus, exploring both elements, as the most frequently mentioned in academic papers, point out to which are the priorities for academics to solve potential difficulties in applying measures by hotel practitioners.

When discussing each water-saving measure assessed and finding established patterns in the research findings, most of the water-saving actions were explored through a double-focus analysis of *ex-ante* and *ex-post* factors (Fig. 2). Bearing this in mind, infrastructural and economic factors were the *ex-ante* factors most often discussed when explaining the implementation of the most water-saving actions while water-saving efficiency assessment was the most analysed *ex-post* factor in terms of the effects of applying the majority of water-saving measures.

In general terms, the results agreed in some cases. In articles analysing *ex-ante* factors, most of the water-saving measures discussed involved infrastructural and/or economic factors as common predictors. As expected, the implementation of "Water prices, taxation and/or licences" measures is not explained by infrastructural issues, since this measure doesn't involve any building adaptation. In the same vein, "Replacement of green zones with pavements" measures are not determined by any economic predictor, as the results point out. Legal requirements are also common predictors and usually present similar results in the articles analysed. Specifically, in-room measures such as the use of dual flush toilets, or the replacement of regular taps and/or shower heads with water-saving devices, are being applied due to the replacement of outdated facilities with new products existing in the market which already incorporate water-saving mechanisms (Torres-Bagur et al., 2019). Thus, in this sense, legal frameworks seem to be a predictor of the implementation of water-saving actions. Socio-cultural factors are another *ex-ante* element that affects the level of implementation of most of the applied measures. In particular, the experience of drought and the associated perception of the risk of drought are factors that could lead managers to intervene to minimise potential damages (Brandão et al., 2018; Dinarès and Saurí, 2015; ElShafei, 2020). Business strategy factors have been found to be a common predictor in most of the measures applied, except "Water prices, taxation and/or licenses" and "Replacement of HVAC with water-efficient devices". In the articles focused on this issue, marketing and corporate image improvement were frequently found to be *ex-ante* factors that explained the implementation level of any water-saving action (Dinarès and Saurí, 2015; Llausàs et al., 2020).

About the *ex-post* factors, there was clear agreement on the efficiency of the low-cost interventions assessed in the articles. Actions with low investment costs and/or short payback periods were shown to be highly efficient because they can significantly reduce water consumption. Low-cost mechanisms were proven to be important water-savers in all the articles which discuss them (Barberán et al., 2013; Gatt and Schranz, 2015; Klontza et al., 2016; Styles et al., 2015). Regarding water consumption and economic cost reduction in applying water-saving actions, several articles aimed at quantifying these two specific indicators. For the first, applying rainwater harvesting actions can potentially reduce, depending on the case study analysed, 26.57% (Klontza et al., 2016) or 60% (Abdallah and Al Antary, 2020) in total water consumption from the supply network, minimizing the pressure over conventional water resources and also decreasing reliance on public drinking water. The use of reclaimed water is also significant: depending on its characteristics, a hotel can reuse a significant volume of reclaimed water, ranging from 10,250 to 30,750 m^3 annually (Hocaoglu, 2017). For the second indicator, in a Jordanian case study, a rainwater harvesting system saved JD1035,408 (Jordanian dinars) annually (Abdallah and Al Antary, 2020), while in a Greek case study, annual monetary savings reached €3500 (Klontza et al., 2016). The potential monetary savings range from €110,000 to €380,000 annually for a 3-star hotel applying low-cost measures (Gatt and Schranz, 2015). In some cases, the installation cost and payback period are also calculated to concretely establish the specific cost-benefit result. Advanced high-tech measures that require a high initial investment, as mentioned by Gabarda-Mallorquí and Ribas (2018), such as the production of reclaimed water, have received particular attention. In the case study of a hotel located in Mallorca (Spain), the total annual cost of installing a reclaimed water system was €15,351 (Gual et al., 2008), while in hotels on small and medium-sized Greek islands in the Aegean Sea, the unit cost per cubic metre, including capital, depreciation, energy and maintenance, ranges from $0.25 to $0.85 (Gikas and Tchobanoglous, 2009). Despite varying implementation and water costs, in some cases, the payback period for investors is longer than in others. In Spanish conditions, the payback period is

Table 5
Number of documents by main research findings.

	Number of documents	Reference number
Water-saving measures implementation predictors	**17***	
Business strategical factors	3	17, 19, 28
Environmental awareness factors	2	19, 28
Legal factors	2	19, 31
Technical factors	4	2, 25, 28, 31
Socio-cultural factors	7	2, 3, 17, 18, 19, 28, 31
Infrastructural factors	11	1, 5, 6, 9, 17, 19, 20, 24, 25, 28, 30
Economic factors	10	1, 2, 14, 17, 19, 25, 28, 30, 31, 33
Water-saving measures implementation effects	**25***	
Normative compliance	4	4, 10, 11, 23
Economic and/or financial analysis	9	1, 6, 8, 11, 12, 13, 21, 22, 23
Environmental impacts identification	1	13
Water-saving efficiency assessment	21	1, 5, 6, 7, 8, 9, 12, 14, 15, 16, 21, 22, 23, 24, 26, 27, 29, 30, 31, 32, 33

* Number of different documents, not the sum of documents in each group item.

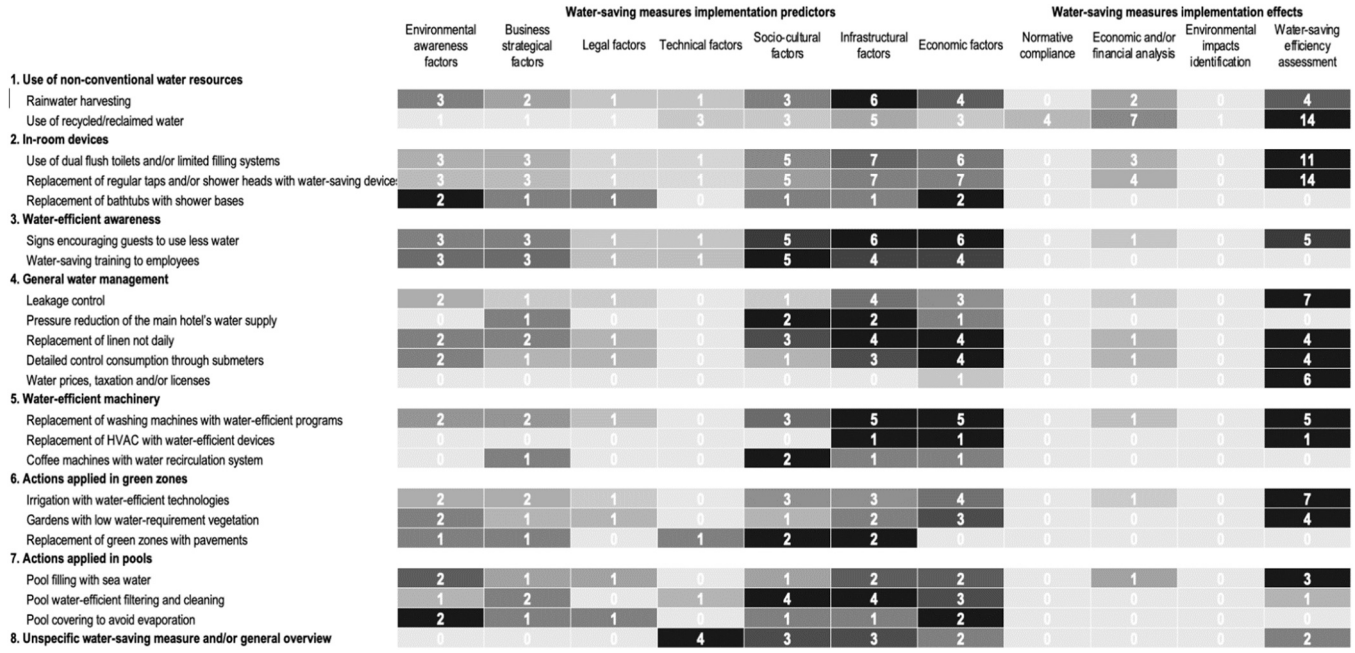


Fig. 2. Number of documents analysing water-saving actions according to their findings*. * *Cells are coloured according to the minimum and maximum per row.*

estimated to be seven years (Atanasova et al., 2017), while in northern China it is 1.3 years (Chai et al., 2013).

Despite the previous common findings, in many of the articles analysed, the main conclusions seem to differ. Firstly, environmental awareness appears as a predictor in some studies (Torres-Bagur et al., 2019). However, in other study cases, this *ex-ante* factor is not a clear motivator (Llausàs et al., 2020). In the same way, articles aimed at exploring infrastructural factors as *ex-ante* predictors point out different findings. Several articles highlight the importance of selecting the proper water-saving technology according to the characteristics of the hotel (Hocaoglu, 2017) since there are still some infrastructural constraints on the application of water-saving actions, especially advanced measures such as rainwater harvesting systems (Abdallah and Al Antary, 2020) or reclaimed water production (Peters, 2015). Focusing on the size of the hotel, several articles affirm that high-capacity (Arun and Faraday, 2019; Kasim et al., 2017; Styles et al., 2015) and/or highly-rated hotels (Dinarès and Saurí, 2015; Tirado et al., 2019) are applying more water-saving measures because they tend to have high technical and/or economic capacities. However, other studies suggest that hotel characteristics are not a clear predictor (Llausàs et al., 2020). It is also unclear whether efficiency can be associated with economic measures such as prices, taxation and/or licenses. While some articles confirm that high water tariffs can lead to a significant reduction in water consumption (Razumova et al., 2016), others state that progressive tariffs aimed at reducing consumption do not always result in water consumption reduction (Deyà-Tortella et al., 2019) because higher water prices don't lead to less water use in hotels (Deyà-Tortella et al., 2016).

3.8. About the stakeholders

To respond to the third research question, (RQ3) Which are the stakeholders identified as key actors involved in water-saving measures implementation and management?, the stakeholders analysed in the articles were identified and classified according to three sub-codes: hotel sector, public administration, and other service-based companies (Table 6). The first sub-code, hotel sector, refers to (1) pilot hotels as built accommodation, where the research was conducted; (2) hotel competition, mainly representing hotels other than those tested in the articles yet somehow involved in the research; or (3) hotel managers, referring to the person who was in charge and was, in fact, the main object of the study. The 'other service-based companies' sub-code refers to other companies involved in the sector, such as supply-licensed companies and/or environmental consultancy services.Table 7

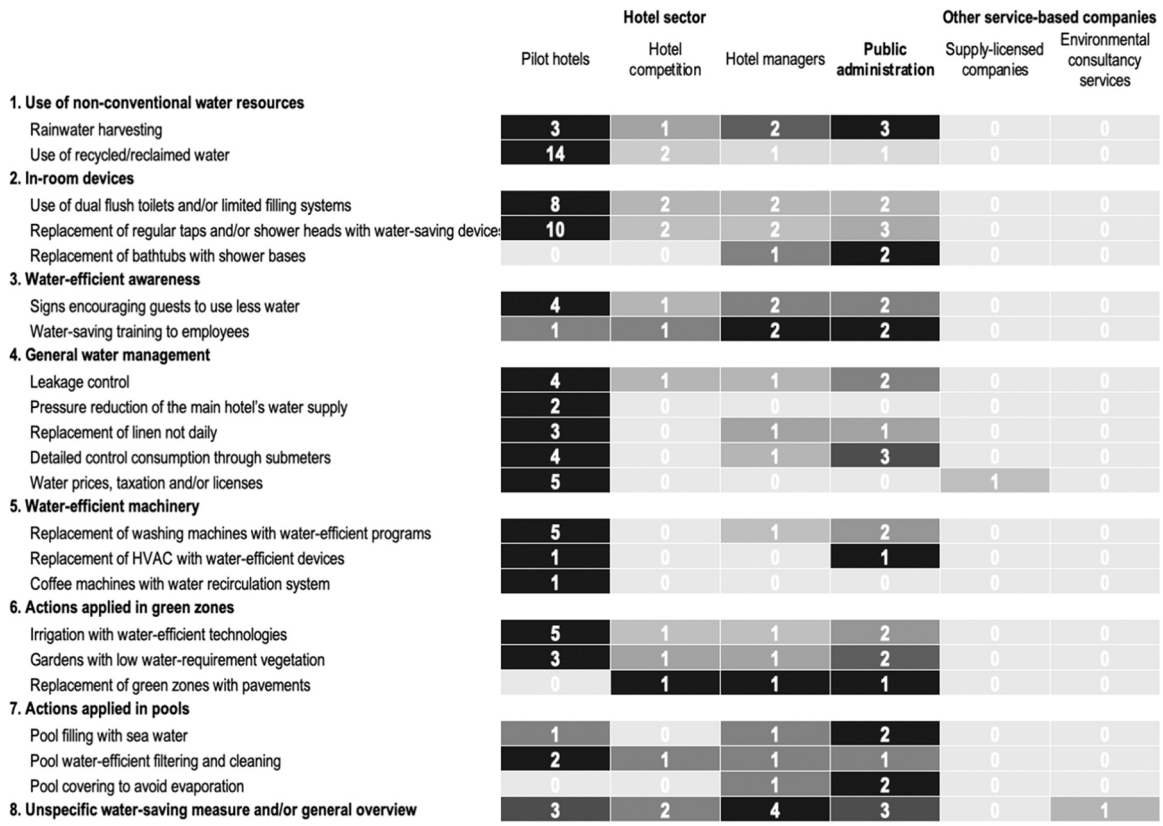
Table 6
Number of documents by stakeholder explored and/or mentioned as a representative actor.

	Number of documents	Reference number
Hotel sector	**33***	
Pilot hotels	28	All the documents except 3, 18, 19, 25, 28
Hotel competition	4	2, 18, 28, 29
Hotel managers	6	3, 9, 18, 19, 25, 28
Public administration	**5**	1, 2, 12, 19, 25
Other service-based companies	**2***	
Supply-licensed companies	1	27
Environmental consultancy services	1	2

* Number of different documents, not the sum of documents in each group item.

Analysis of the stakeholders involved and/or mentioned is also important, as it indicates which of these actors were defined as essential elements in the research conducted (Fig. 3). The stakeholders appearing in the studies were pilot hotels where new technologies were being tested. The research conducted in almost all the articles aimed to test, explore, or analyse one or more water-saving measures in a representative sample of hotel buildings. Although in a few articles, hotel managers were also of interest (seven articles), especially when *ex-ante* factors were the main focus of the research (Brandão et al., 2018; ElShafei, 2020; Kasim et al., 2014; Llausàs et al., 2020; Torres-Bagur et al., 2019). Moreover, it is worth highlighting the number of different documents mentioning public administration as a stakeholder involved in water-saving practices in the hotel sector (five documents) playing important roles in promoting and funding water-saving measures.

However, there is no clear agreement on the role that the public



	Hotel sector				Other service-based companies	
	Pilot hotels	Hotel competition	Hotel managers	Public administration	Supply-licensed companies	Environmental consultancy services
1. Use of non-conventional water resources						
Rainwater harvesting	3	1	2	3	0	0
Use of recycled/reclaimed water	14	2	1	1	0	0
2. In-room devices						
Use of dual flush toilets and/or limited filling systems	8	2	2	2	0	0
Replacement of regular taps and/or shower heads with water-saving devices	10	2	2	3	0	0
Replacement of bathtubs with shower bases	0	0	1	2	0	0
3. Water-efficient awareness						
Signs encouraging guests to use less water	4	1	2	2	0	0
Water-saving training to employees	1	1	2	2	0	0
4. General water management						
Leakage control	4	1	1	2	0	0
Pressure reduction of the main hotel's water supply	2	0	0	0	0	0
Replacement of linen not daily	3	0	1	1	0	0
Detailed control consumption through submeters	4	0	1	3	0	0
Water prices, taxation and/or licenses	5	0	0	0	1	0
5. Water-efficient machinery						
Replacement of washing machines with water-efficient programs	5	0	1	2	0	0
Replacement of HVAC with water-efficient devices	1	0	0	1	0	0
Coffee machines with water recirculation system	1	0	0	0	0	0
6. Actions applied in green zones						
Irrigation with water-efficient technologies	5	1	1	2	0	0
Gardens with low water-requirement vegetation	3	1	1	2	0	0
Replacement of green zones with pavements	0	1	1	1	0	0
7. Actions applied in pools						
Pool filling with sea water	1	0	1	2	0	0
Pool water-efficient filtering and cleaning	2	1	1	1	0	0
Pool covering to avoid evaporation	0	0	1	2	0	0
8. Unspecific water-saving measure and/or general overview	3	2	4	3	0	1

Fig. 3. Number of documents analysing water-saving actions according to the stakeholders involved or mentioned*. * *Cells are coloured according to the minimum and maximum per row.*

sector needs to play in managing water-saving initiatives. While in some cases public administration was seen as a fundamental source of funding (Alonso, 2008), in others this was not seen as its main role (Barberán et al., 2013). Less-mentioned stakeholders include hotel companies other than pilot hotels, and other service-based companies such as supply-licensed companies and environmental advisors. In some cases, the role of other hotel companies has been considered to be a key element in transferring expertise (Llausàs et al., 2020) and exchanging knowledge of best practices in water-saving (Alonso, 2008). However, according to the figures, it can be stated that these studies have mostly centred on the analysis of one individual hotel, and external stakeholders such as other hotel companies and/or other external services have not been widely considered.

4. Discussion and conclusions

Bearing the results in mind, some issues need to be thoroughly discussed. Regarding authorship, the different disciplines involved in hotel water-saving actions confirm that the exploration, testing and/or analysis of actions aimed at reducing water consumption in hotels involves a multidisciplinary approach because multiple points of view must be considered when elucidating the socioeconomic and environmental feasibility of a specific water-saving practice. In general terms, water implies social, economic, environmental, and technical issues when it becomes a basic need. In fact, the own nature of water combines biophysical and socio-political elements that must be considered comprehensively (Swyngedouw, 2009). Thus, research in water-saving actions requires engineering, socioeconomic, and environmental experts and this indeed enriches the research in the field. On the other hand, and as mentioned previously, universities lead the ranking of the typology of institutions the authors are affiliated with, followed by research centres. This is linked to a general trend worldwide observed: universities play an essential role in research and knowledge production (Lopes et al., 2021). However, private for-profit entities and public organisations are underrepresented as collaborators in and/or conductors of research linked to water-saving measures in the hotel sector. This has led to the fact that knowledge production and transferability have been less noticeable in tourism than in other economic sectors (H. Xiao and Smith, 2007). While private entities (mainly hotel companies) collaborated with most of the articles analysed, usually as pilot studies, there is still a long way to go before they can be converted into real knowledge creators.

As for the main typology of water-saving actions applied, hotels tend to apply low-cost water-saving initiatives much more intensively than those that entail a high cost for hotels (Barberán et al., 2013). According to the results, research is advancing in the same direction since two of the top three most explored measures are in fact low-cost actions: the replacement of regular taps and/or shower heads with water-saving devices (explored in 12 documents) and the use of dual flush toilets and/or limited filling systems (10 documents). This could be explained by the fact that the highest amount of water use in accommodation takes place in rooms (Gössling, 2015), and so it is where water consumption might be potentially reduced to a greater extent. Nevertheless, since a positive link between the introduction of these measures and the cost indicators of hotels would be expected, higher levels of efficiency in the use of water would allow the hotel to reduce operative costs, and with it, an improvement in its profit margins. Currently, water costs are still significantly low for hotel companies in many countries. For example, the study of Deyá and Tirado (2011) concludes that water costs account for 4% of total hotel costs, while Gössling et al. (2012) concludes that they represent 0.6% of turnover in Steiermark (Austria) and 1.6% of turnover in Morocco. If a cost-benefit analysis linked to the implementation of a specific water-saving action is considered, it is expected that the cost of the volume of water saved should be higher than the

investment of the measure itself allowing greater cost efficiency. However, due to the low price of water, hotel managers tend to seek those economical water-saving actions. This fact could explain the low level of high-cost initiatives applied. For this reason, and in line with several regulations and recommendations from different international organisms, to achieve sustainable and efficient water consumption levels, it is essential that the price of water reflects its real cost. In this sense, for instance, the European Union launched the Water Framework Directive 2000/60/EC (WFD), based on the United Nations Conference on Environment and Development principles. The directive recommends the introduction of new tariff systems allowing all water-related costs to be recovered (including financial, environmental, and resource costs). For this purpose, market pricing and incentives play an important role as mechanisms for more efficient use of water and its conservation (Charara et al., 2011).

Despite the mentioned before, according to this review, the first ranked most explored measure is the use of recycled/reclaimed water from sewage produced within the hotel premises (explored in 15 documents), which is in fact a high-cost practice with high technical requirements that provides clean water only for non-drinking outdoor purposes. Although this action could not be of interest to hotel managers and practitioners due to high initial investment and operational costs, according to the papers reviewed the use of reclaimed water in hotels is a highly explored scientific topic. In this case, research is effectively testing the technology and checking the conditions for a proper implementation of this measure. In this sense, and even though practitioners are not generally interested in applying such high-tech action, academics are moving faster and minimizing the likelihood of errors that could jeopardize the implementation of this technology. Somehow, in this case, science is providing the needed information to highlight the significant benefits of using this non-conventional water resource. The use of reclaimed water is thought to be essential in the transition towards the circular economy (Mannina et al., 2022) and is also seen as a potential non-conventional water resource in dealing with water-stressed tourist destinations (Gabarda-Mallorquí et al., 2016). In that sense, the circular economy is included in one of the six lines of action proposed in the World Tourism Organization's "Rethinking tourism. From crisis to transformation" strategic plan (VV.AA., 2022) since the tourism sector is fundamental in achieving the Sustainable Development Goals (Gabarda-Mallorquí and Fraguell, 2020). As a matter of fact, international hotel chains have recently incorporated circularity-based actions in their corporate management dealing with energy, food, and water overconsumption (Leyva and Parra, 2021). Research in the use of reclaimed water in the hotel sector is moving towards a parallel direction and advancing knowledge on this important water resource to shed new light on the tourism-based circular economy transition.

4.1. Implications for academic research

In view of the research findings pointed out in the papers analysed, some gaps have been identified, responding to the fourth research question, (RQ4) What are the main gaps to be potentially filled by research from any scientific field?. In general terms, two main issues relating to the *ex-post* analysis of water-saving actions have not yet been adequately explored, despite their potential importance, and constitute a potential research area for academia. On one hand, none of the water-saving measures was analysed in terms of business strategy as a potential effect since no articles have analysed the impact the introduction of water-saving actions could have on hotels' competitiveness. Although legal regulations or tax incentives can indeed help to boost or expand the levels of implementation of water-saving actions, they cannot be the only factor that determines the implementation of these measures. A committed sustainable way to guarantee water-saving actions' implementation and improvement is by showing the business sector its positive effects on the hotel's competitiveness.

On the other, exploring the potential effects of introducing water-saving measures on the competitiveness of hotels could be a very useful output for hotel managers and would increase the incentives and motivation to implement water-saving actions in hotels. Pro-environmental initiatives lead to higher efficiency (that will lead to better profit margins) and tend to improve hotels' image for customers, increasing their loyalty levels, revisiting intention, and willingness to pay (Fraj et al., 2015). In addition, the growing sensitivity of customers to the environmental management carried out in hotels has led to strong pressures on managers. Hotels that do not implement an effective environmental policy within their facilities are increasingly penalized by their customers. Thus, it seems rational to expect that those hotels with proactive water management would tend to display better levels of competitiveness, both from revenues and cost sides. Academic research in this field would help to demonstrate to hotel managers that the introduction of water-saving measures not only generates environmental returns but also an economic return for the hotel. This would undoubtedly facilitate and accelerate the implementation of these measures in hotels.

Regarding the stakeholders explored, it must be noted that the analyses centred on one hotel do not allow for the systemic exploration of each of the water-saving measures. Most of the articles analysed focused on one hotel as the main stakeholder involved in water-saving management, and there was a clear lack of research on the role of other essential stakeholders. In this sense, Cole (2014) conducted an in-depth and nuanced study to identify the role of key stakeholders involved in the water management of tourist destinations. From a Political Ecology approach, the author considered villa owners, community leaders, local organizations, and/or government departments, among others, as the main groups that compound the stakeholder map. Identifying all the stakeholders involved in promoting, managing, and fostering water-saving initiatives and how they cooperate is a fundamental milestone in building a proper partnership for adaptation to climate change (Cole, 2012). In this sense, water-centred circularity strategies need to be adopted considering the myriad of stakeholders involved in a tourist destination.

4.2. Managerial implications

One of the main findings of this research is that it is important to distinguish between the water-saving actions that hotels mostly apply and the measures that are mostly the subject of analysis by academia. As observed, one of the main focuses of research is currently the production of reclaimed water. By doing that, the academy is somehow guiding the hotel sector on how to reuse its own wastewater. As pointed out by the results, it seems that the main predictors in the case of the use of reclaimed water are technical/infrastructural and economic factors, while environmental awareness is not one of the main factors that leads hotel managers to apply this measure. Thus, the role of international organizations and public administrations is essential to encourage and/or include circular strategies in hotels, and therefore, to produce and use their reclaimed water. In this sense, regional, national and/or international hydrological policies need to advance in the promotion of the use of reclaimed water through an optimal design of regulations and economic instruments. To encourage the adoption of this kind of measures, higher public investments in infrastructures are also needed to hotels consume reclaimed water from public water supply (such as a parallel distribution network for reclaimed water).

The results of this study could be useful to both policy and hotel decision-makers. The more frequent and even severe drought periods are pushing policymakers to design strategic plans to streamline water use and consumption in the hotel sector. As mentioned before, and due to the huge impact on water resources related to hotel services, especially in coastal tourist destinations, the implementation of efficient water management policies in hotels is undoubtedly crucial to ensure viable and competitive tourist destinations. In this sense, while it is true

that water price can be a proper instrument to moderate consumption, it should not be the only one. Since a considerable volume of water consumption takes place in hotel rooms, guests do not directly assume water costs and the effectiveness linked to water prices could be significantly reduced. Thus, the introduction of legal and tax-based mechanisms to encourage hotels to introduce water-saving actions must be essential. Bearing this in mind, the results of this review provide a clear approach to policy and hotel decision-makers to design and implement efficient measures to reduce water consumption and/or to find solutions to minimize the impact on water resources.

Finally, it should be noted that the hotel sector is characterized by many tourist destinations to be extremely atomized. In this sense, the sector is composed of several types of companies. The introduction of water-saving measures in this type of company tends to be complex due to the lack of financial resources, the reduced economy scale, or the lack of effective information regarding the options and the efficiency of potential water-saving actions. All in all, another managerial implication is linked to the assessment regarding the existing actions to save water that could be implemented by hotel managers.

4.3. Limitations

It should be mentioned that this study has some limitations. One limitation of the study is the subjective nature of the systematic review of the literature, as it is a qualitative technique, so there may be a bias in the interpretation of the results. Although other methodologies can avoid or reduce this bias, such as bibliometric analysis and meta-analysis, the specificity of the object of study and the scarcity of data have not made the use of these methodologies appropriate. Related with this, several exclusion criteria were used to select the articles most appropriate to the main goal of this review and maybe papers relevant to the objectives of the study. For this reason, the authors could explore extending this study to incorporate the new existing literature on this topic and thus compare these two methodologies.

On the other hand, although the WoS and Scopus databases have been shown to be the most used search engines for scientific research, it is also worth mentioning the importance of non-academic journals as an essential information source for hotel managers and practitioners. Although they are not of a research nature, these practitioner-oriented magazines could lead hotel managers to adapt their infrastructures and services and so reduce water consumption. This fact would be more likely to result from non-academic magazines than scientific journals, linked to a bandwagon effect. Thus, comparing this review with the water-saving practices discussed in non-academic journals would allow valuable analysis if research, in a broader sense, is gathering information on the real efforts made to save water in the hotel sector.

4.4. Suggestions for further research

Once the state of the art on water saving actions carried out in the hotel sector have been compiled, further research proposals based on the main findings and gaps detected are detailed next. First, a lack of research on the role of other crucial stakeholders has been detected. Thus, further research in defining and understanding all the stakeholders involved in water management and consumption is essential in transitioning to the circular economy in the hotel sector. Linked to that and according to published studies, even though residents (Bujosa and Rosselló, 2007; Puczkó and Rátz, 2000) and customers (Rodriguez–Sanchez et al., 2020) are aware of the importance of saving water by the tourism industry, the literature included in this review does not consider them to be key actors in the management of water. In this sense, further research is needed to determine how an action can affect guests' behaviour during their stay. Potentially research topics could be based on experiments to determine if customers consume water according to the values they report to have. In this sense, the authors intend to open a new line of research in this regard by conducting behavioural experiments on hotel guests. New available technologies, such as smart water meters, allow to gathering of data on real water consumption in hotels, an essential aspect to continue advancing in the field of water saving through circular strategies in the tourism sector.

Secondly, and related to the above, it is important to note that most of the studies reveal that the main difficulty faced by researchers in this field is the non-existence of official databases with cross-sectional or temporary samples large enough to conduct statistically robust research. The development of information and communication technologies (ICT) brings the opportunity to install digital sensors capable of measuring water consumption in real-time. These digital systems allow researchers to analyse guests' behaviour patterns, as well as to explore the effectiveness of the water-saving measures applied to hotels. As verified in this study, few studies have addressed this issue by measuring water consumption in different hotel departments through submeters. Further research could be conducted to explore the real effectiveness of any water-saving action.

Finally, another potential research in the field of water-saving in hotels could be focused on the exploration of several existing management models. During the last decade, new models of hotel management have exponentially appeared, such as the management contracts in which the property and the manager fall on two different actors. In this sense, the property assets belong to local companies, real estate companies or investment funds, while big hotel chains are in charge of the management. Although chain affiliation can reduce financial difficulties, increase scale economies, and facilitate the introduction of innovative issues (Orfila-Sintes and Mattsson, 2009), these contracts can lead to non-desired effects. The most frequently common presence of investment funds, the high temporality of the contracts and/or the rotation in the management companies threaten the introduction of water-saving measures, especially when the actions have a long payback period. To the authors' knowledge, no academic article has attempted to analyse the introduction of water-saving actions in this specific management model. Undoubtedly, this fact constitutes a plausible further research line, considering the importance that hotel management contracts have worldwide.

CRediT authorship contribution statement

Dolores Tirado: Conceptualization, Data curation, Funding acquisition, Resources, Writing – review & editing. **Ariadna Gabarda-Mallorquí:** Conceptualization, Data curation, Methodology, Software, Writing – original draft. **Bartolomé Deyá Tortella:** Conceptualization, Data curation, Funding acquisition, Resources, Writing – review & editing.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Table 7
Records included in this review.

ID	Reference	Authorship background	Journal field (according to UNESCO standardization)[a]	Research method	Study case
1	(Abdallah and Al Antary, 2020)	Mixed	Technological Sciences	Quantitative	Jordan
2	(Alonso, 2008)	Economic Sciences	Economic Sciences	Mixed	Australia
3	(Brandão et al., 2018)	Economic Sciences	Technological Sciences	Qualitative	Brazil
4	(Gattringer et al., 2016)	Technological Sciences	Geography	Quantitative	Spain
5	(Kasim et al., 2017)	Economic Sciences	Economic Sciences	Quantitative	Malaysia
6	(Klontza et al., 2016)	Mixed	Technological Sciences	Quantitative	Greece
7	(Toyosada et al., 2016)	Technological Sciences	Technological Sciences	Quantitative	Vietnam
8	(Rysulova et al., 2015)	Sciences of Arts and Letters	Geography	Quantitative	Slovakia
9	(Arun and Faraday, 2019)	Economic Sciences	Medical Sciences	Mixed	India
10	(Antakyali et al., 2008)	Technological Sciences	Technological Sciences	Quantitative	Turkey
11	(Atanasova et al., 2017)	Technological Sciences	Technological Sciences	Quantitative	Spain
12	(Barberán et al., 2013)	Economic Sciences	Economic Sciences	Quantitative	Spain
13	(Chai et al., 2013)	Technological Sciences	Technological Sciences	Quantitative	China
14	(Chan et al., 2009)	Mixed	Economic Sciences	Mixed	Hong Kong
15	(Deyà-Tortella et al., 2019)	Mixed	Economic Sciences	Quantitative	Spain
16	(Deyà-Tortella et al., 2016)	Mixed	Economic Sciences	Quantitative	Spain
17	(Dinarès and Saurí, 2015)	Geography	Geography	Quantitative	Spain
18	(ElShafei, 2020)	Technological Sciences	Technological Sciences	Quantitative	United Arab Emirates
19	(Torres-Bagur et al., 2019)	Geography	Technological Sciences	Qualitative	Spain
20	(Tirado et al., 2019)	Mixed	Technological Sciences	Quantitative	Spain
21	(Gatt and Schranz, 2015)	Sciences of Arts and Letters	Economic Sciences	Quantitative	Malta
22	(Gikas and Tchobanoglous, 2009)	Technological Sciences	Technological Sciences	Quantitative	Greece
23	(Gual et al., 2008)	Mixed	Technological Sciences	Quantitative	Spain
24	(Hocaoglu, 2017)	Technological Sciences	Technological Sciences	Quantitative	Turkey
25	(Kasim et al., 2014)	Economic Sciences	Economic Sciences	Qualitative	Malaysia
26	(Lamei, Van Der Zaag, et al., 2009)	Technological Sciences	Technological Sciences	Quantitative	Egypt
27	(Lamei, Von Münch, et al., 2009)	Technological Sciences	Technological Sciences	Quantitative	Egypt
28	(Llausàs et al., 2020)	Geography	Economic Sciences	Qualitative	Spain
29	(Mclennan et al., 2017)	Economic Sciences	Economic Sciences	Quantitative	Australia, Hong Kong, Singapore, New Zealand, Indonesia, Thailand
30	(Styles et al., 2015)	Technological Sciences	Economic Sciences	Quantitative	Unknown
31	(Peters, 2015)	Technological Sciences	Technological Sciences	Mixed	Anguilla, Antigua, Barbados, Dominica, Grenada, St Lucia, St Vincent and the Grenadines, St Kitts and Nevis, Tobago
32	(Razumova et al., 2016)	Economic Sciences	Economic Sciences	Quantitative	Spain
33	(Rico et al., 2019)	Geography	Economic Sciences	Quantitative	Spain

[a] See the Recommendation concerning the International Standardisation of Statistics on Science and Technology (https://www.unesco.org/en/legal-affairs/recommendation-concerning-international-standardization-statistics-science-and-technology)

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