

Review

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Review

Environmental Sustainability in Hotels: A Review of the Relevance and Contributions of Assessment Tools and Techniques

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Abstract: The hospitality industry is a major segment of Tourism which is in turn a main economic contributor for instance for Small Island Developing States (SIDS). Sustainable tourism practices are promoted worldwide by international organizations like the United Nations World Tourism Organisation (UNWTO) to assist different countries. Varied frameworks such as the Global Reporting Initiative (GRI), the Sustainable Development Goals (SDGs), United Nations Global Compact (UNGC) and environmental indices and management systems such as ISO 14001 are common assessment tools for environmental sustainability. This research reviews the relevance of incorporating environmental and socio-economic factors within hotel operations which may lead to improved transparency, and operational effectiveness while guaranteeing adherence to sustainability within the hotel business. Accordingly, a comprehensive review of environmental sustainability assessment in hotels was carried out. A comprehensive analysis of research articles published between January 2000 and January 2023 by reputed databases ranging from Google Scholar, Scopus, and others, were used to conduct the literature review. A total of 38 papers were examined adhering to the PRISMA standards and it is worth noting that a significant increase in interest emerged from 2018, especially in Europe and Asia. The review reiterated the relevance and need to use relevant assessment methods and tools that aid in implementing sustainable development strategies to promote tourism-dependent economies, particularly in Small Island Developing States (SIDS). It additionally provides valuable knowledge for future directions, whilst improving research methods and incorporating innovative technologies. These advancements are essential as they may guide policy decisions to protect the environment in the hospitality industry.

Keywords: hotel sector; environmental sustainability; environmental sustainability assessment; assessment tools and techniques

1. Introduction

The environmental sustainability aspect within sustainable development has become a major issue of concern to the hospitality industry most especially in the hotel industries. Hospitality entails the use of large proportions of resources such as water, energy and other materials during the provision of services such as accommodation hence raises to requirements large volumes of resources which cause wastage and unwanted emissions of greenhouse gases [1–4].

The hotel industry's impacts can be significantly substantial because it entails the consumption of enormous amounts of energy for heating, cooling, and lighting, water for washing guests, and other activities, as well as water for maintaining its beautiful landscapes. Recent studies highlight that hotels contribute to 1% of global carbon emissions, emphasizing the need for sustainable practices [5]. When talking about waste in hospitality, it is necessary to highlight that this concept involves not only solid waste that emerges during the functioning of hotels but also wastewater and emissions that harm the environment [6,7].

Due to their strong reliance on tourism, scarcity of natural resources, susceptibility to climate change, and requirement for sustainable waste management, hotels in island states confront particular difficulties. The Caribbean Hotel Energy Efficiency and Renewable Energy Action (CHENACT) project, for instance, showed how energy efficiency measures might cut energy usage in Caribbean hotels by as much as 30% [8]. Furthermore, for long-term sustainability, water-saving methods and technologies must be adopted in island regions due to water shortages [9,10]. For the hospitality industry in these areas to grow sustainably, these problems must be resolved [6].

Customers' expectations of hotels to adopt sustainable solutions are growing as a result of environmental concerns [7,11]. The hotel industry has adopted sustainable practices as a result of this shift in customer expectations, increased regulatory scrutiny, and climate change-related legislation [12]. The growing frequency of climate-related disasters like hurricanes and floods, which have a direct effect on places that depend heavily on tourism, highlights the urgency [13]. Hotels have to deal with issues like cutting carbon emissions, using renewable energy sources, and effectively managing water resources [6,12]. Environmental sustainability is becoming increasingly important in the tourism business, according to recent research that shows a growing consumer desire for eco-friendly hotels [7,14]. Because of these consumer and governmental demands, environmental sustainability is becoming a top priority for hotels all over the world.

The integration of sustainability measures in the hospitality industry, especially in hotels, has many advantages. Effective management of environmental policies not only addresses ecological concerns but also enhances the image and reputation of hotels. A study by [14] highlights that hotels with strong sustainability practices attract more environmentally conscious travelers thereby boosting their marketability. Additionally, a report by [15] indicates that implementing green practices can lead to significant cost savings through energy efficiency and waste reduction. These factors collectively contribute to a positive brand image and can improve customer loyalty and satisfaction. Furthermore, the implementation of efficient technologies and proper waste management tackles the conservation of energy, which in turn results in cost savings, enhanced operational performance, and increased profits are positive outcomes for hotels. Recent studies confirmed that hotels investing in energy-efficient technologies can reduce operational costs by up to 30% [8]. Moreover, effective waste management practices contribute to significant savings and environmental benefits [15]. Thus, the inclusion of environmental sustainability issues is not purely a matter of ethics that supports managerial priorities, but it is also a strategic approach to achieving long-term business success.

Although the study of environmental sustainability in the hotel sector is becoming more and more common, the literature currently in publication shows that the techniques and instruments employed to evaluate sustainability performance are not well defined [16,17]. Prior studies have concentrated on water optimisation, waste reduction, and energy conservation in hotels; however, a thorough comparison of the major strategies is lacking. Furthermore, little is known about small island nations that depend largely on tourism and have particular sustainability issues because of their inadequate infrastructure and resource availability [8,14].

Sustainability policies and practices are integrated in various hotel activities and operations. Nevertheless, environmental sustainability assessment and the use of relevant assessment tools remain important areas of research interest as this sector requires ongoing evaluation and optimization methods necessary to foster sustainable tourism as a whole [18]. Additionally, the use and application of environmental sustainability assessment tools which is known to contribute to the overall hotel sustainability sets a comprehensive way to measure and also evaluate major hotel operations such as energy and water management as well as solid and food waste among others [19]. Environmental assessment tools play a major role in the hotel industry as it facilitate and coordinate the easy integration of sustainable practices into actions. It was hence determinant to synthesise existing research to offer a robust conceptual framework, and assess the sound application of various approaches thus a systematic review. A review like this will point out the benefits and drawbacks of the studies that are now available and suggest areas for additional investigation. According to [12,16] recent studies emphasise the significance of thorough reviews for benchmarking sustainability

practices, which are essential for developing models that hotels may use to improve their sustainability and solve environmental concerns [20].

While there is a rapidly increasing interest in researching environmental sustainability in hotels, several research gaps were identified. Firstly, the general problem is the absence of common methods for evaluating sustainability performance in comparison with the regional and the typology of hotels. Research shows that the majority of the studies are conducted in specific contexts denying an interdisciplinary framework to make comparisons across the results [11]. Secondly, it has been observed that the majority of the prior studies have been geared towards the environmental aspect of sustainability, and there is scarce research on the type of configurational integration of the social and economic aspects in sustainability evaluations. For that purpose, there is a requirement of a multi-dimensional perspective that also includes the other two sustainability dimensions for a detailed assessment of the hotels performance [21]. Thirdly, the importance of longitudinal studies that consider the change in sample hotel's sustainability performance over time is well explained. Majority of the earlier studies thus offer a cross-sectional view of the practices, without offering manner on the effects of sustainable practices [22,23].

Finally, there is inadequate literature concerning the adoption and implementation of emerging technologies/innovation towards the advancement of sustainability in the hotel business. More research should be conducted on the application of current and emerging technologies like blockchain, artificial intelligence, and the IoT in improving sustainability processes and performance [24–26]. As such, this paper aims to conduct systematic literature reviewing of research papers published on understanding the relevance of the assessment of environmental sustainability tools and methods in hotels. It will also identify and categorize the various approaches and tools used for environmental sustainability assessment in hotels and relate to the effectiveness and applicability of these assessment methods. Thus, this review aims to contribute the results of the analysis of the current state of environmental sustainability assessment studies conducted in the hotel industry to researchers, policymakers, and practitioners by analyzing the application of these approaches across different regions and hotel types. This systematic review aims to illuminate the current research gaps regarding environmental sustainability assessment in the hotel industry and contribute to suggestions for enhancing sustainability within the sector. It will additionally assist through literature gaps formulated in identifying and comparing the level of success of various assessment tools and strategies, thereby enhancing the formulation of better ways of assessing the efficiency and sustainability of the hotel industry's environmental management initiatives.

2. Materials and Methods

This systematic review is aligned with the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) checklists as a useful tool for carrying out an SR. PRISMA framework makes the review process systematic, it was conducted in a clear manner and other researcher can easily conduct the same study if needed [27,28]. The review process involves several stages: The planning phase, the review phase, and the reporting and dissemination phase. Every step is properly conducted in a way that reduces the impact of Bias and increases the level of reliability of the results and all searches was based on the following research questions:

RQ1: What are the main approaches and tools used for assessing environmental sustainability in hotels?

RQ2: How effective are these tools and techniques in measuring sustainability performance?

RQ3: What dimensions of environmental sustainability are most commonly assessed in the hotel industry?

RQ 4: How do sustainability assessment practices vary across different regions and types of hotels?

RQ 5: What are the key challenges and limitations associated with current sustainability assessment methods in hotels?

RQ 6: What areas require further research to improve the sustainability assessment practices in the hotel industry?

2.1. Search Strategy

By systematically addressing these questions, this review aims to contribute to the development of a more standardized and comprehensive framework for environmental sustainability assessment in hotels, fostering improved environmental performance and sustainability within the industry. The review was started by creating the review protocol that includes the purpose, sampling criteria for the inclusion and exclusion, search strategy, and the means of data analysis and synthesis. This protocol was also refereed by other professionals to enhance on its reliability and coverage [29] Saulick. In this case, to meet the PRISMA's four-phase flow diagram, the processes of study identification, study screening, study eligibility and inclusion were reported.

- **Keywords:** "environmental sustainability", "sustainability assessment", "hotel industry", "green hotels", "sustainable tourism", "eco-friendly hotels".
- **Search Strings:**
 - "(environmental sustainability OR sustainable development) AND (hotels OR hospitality industry)"
 - "(sustainability assessment) AND (hotels OR hospitality)"
 - "(green hotels OR eco-friendly hotels) AND (sustainability practices)"
 - "(sustainable tourism) AND (hotel industry)"

Besides, to further potential relevant sources, cross-reference snowballing was also used, which means examining references of the chosen articles [30]. The sources uncovered did not have a regional boundary or temporal restriction; however, to cover modern trends and approaches, priority was given to publications from 2000 to 2023.

2.2. Inclusion and Exclusion Criteria

To ensure the relevance and quality of the studies included in this review, specific inclusion and exclusion criteria were established:

- **Inclusion Criteria:**
 - Studies published between 2000 and 2023.
 - Peer-reviewed journal articles, review papers, book chapters, and conference papers.
 - Articles written in English.
 - Studies focusing on environmental sustainability assessment in the hotel industry.
 - Research employing quantitative, qualitative, or mixed-method approaches.
- **Exclusion Criteria:**
 - Duplicate studies.
 - Non-English articles.
 - Studies focusing on sustainability practices outside the hotel industry.
 - Grey literature, such as reports, theses, and dissertations that have not undergone peer review.

The initial search yielded a total of 4,367 articles. After removing duplicates, 1,128 articles remained. A preliminary screening of titles and abstracts further reduced this number to 188 articles. These articles underwent a full-text review, applying the inclusion and exclusion criteria, resulting in a final sample of 38 studies relevant to this systematic review.

2.3. PRISMA Flow Diagram for Study Selection

Identification

- Records identified through database searching: 4,367
- Additional records identified through other sources: 50
- Total records after duplicates removed: 1,128

Screening

- Records screened: 1,128
- Records excluded based on title and abstract: 940

Eligibility

- Full-text articles assessed for eligibility: 188
- Full-text articles excluded, with reasons: 150
 - Not relevant to environmental sustainability in hotels: 90
 - Insufficient methodological detail: 30
 - Non-English language: 20
 - Duplicate records: 10

Included

- Studies included in qualitative synthesis: 38

2.4. Data Extraction and Synthesis

Data extraction was conducted systematically using a pre-defined extraction form to ensure consistency and comprehensiveness. The following information was extracted from each study:

- Bibliographic Details: Authors, publication year, journal name.
- Study Characteristics: Objectives, methodology, sample size, geographic location.
- Assessment Approaches: Specific sustainability assessment methods and tools used.
- Key Findings: Main results and conclusions of the study.
- Sustainability Dimensions: Environmental, social, economic, and other relevant dimensions assessed.
- Techniques Used: Analytical techniques and models employed in the assessment.

The obtained data were analyzed in accordance with the narrative synthesis approach, during which results of the conducted studies are summarized and interpreted. To achieve this synthesis, the investigation revolved around the four research queries in order to offer a clear map of the existing state of environmental sustainability in hotels. T test and ANOVA analyses were applied to present the trend in mean percentage and chi square was used to check for the statistical significance and relationship between the variables used in the study correlational analysis was also performed to determine the co-relation between the study variables Descriptive analysis was used in finding out the trends and patterns of the study variables.

2.5. Validity of Findings

The validity of findings of the studies was evaluated based on specific criteria required for providing methodological credibility to the review [31]. Recent studies, such as those by [27,32]

emphasize the importance of rigorous methodological standards in systematic reviews to ensure credibility and reproducibility. In this way, the process applied in the review will enable a more comprehensive and credible evaluation of the state of practices in environmental sustainability assessment in the hotel industry.

The data extracted from the studies was then narratively synthesized, which entails a review and analysis of the findings within the studies. This synthesis reflected the research questions and offered an outline of the state of the investigation concerning environmental sustainability assessments in hotels [33]. Trend analysis used descriptive statistics, while other analyses incorporated theme analysis to identify commonalities and gaps in the literature [34,35]. To minimize the risk of bias and increase the credibility of the research results, the methodological quality of the included studies was evaluated based on predefined criteria [36].

3. Literature Analytics and Advances

Understanding of the environmental sustainability concept within the hospitality sector has emerged and developed over the last few decades. The hotel industry within the broader hospitality sector became aware of the environmental implications of its operations in the early 1990s, in line with the global awareness of environmentalism and sustainable development [37,38]. The 1992 central event in Rio de Janeiro, commonly known as the Earth Summit, helped catalyze the focus on sustainability, including in the hospitality industry.

During the 1990s and early 2000s, the concepts introduced were fairly simple and comprised recycling programs, energy-efficient practices, and water-efficient measures in hotel operations and the hospitality industry [39,40]. These actions were often uncoordinated and lacked a holistic strategy. However, as environmental degradation became a more pressing issue, the industry developed more comprehensive framework strategies, such as Environmental Management Systems (EMS). The Green Globe, introduced in 1994, provided a model for hotels to measure and enhance their environmental performance.

Recent studies have shown a continued evolution in the industry's sustainability practices. For instance, [41,42] highlight the increasing integration of advanced technologies and data analytics to optimize energy and water use. Furthermore, [43] reports that more hotels are now adopting comprehensive sustainability certifications and frameworks to address broader environmental and social issues [44]. These developments underscore the industry's growing commitment to sustainability and the need for ongoing research and innovation.

The twentieth century particularly the later part and the twenty-first century saw the integration of the hotel industry to environmental sustainability to a greater extent. The expansion of the United Nations' Sustainable Development Goals (SDGs) platform in 2015 also contributed to the industry's preparation for proposed government-implemented sustainable targets [44]. Scientific and technological developments as well as consumers' sensitivity towards environmental problems have prompted organizations like the hotel industry to seek change through the adoption of measures like renewable energy systems, waste conversion technologies, as well as, complete sustainability management systems [45,46].

3.1. Environmental Sustainability: The Key Concepts and Definitions

To effectively discuss environmental sustainability in hotels, it is essential to define key concepts and terms related to sustainability assessment:

- Environmental Sustainability: Refers to practices that ensure the long-term health of the environment by conserving natural resources, reducing pollution, and promoting ecological balance [46,47].
- Sustainability Assessment: The process of evaluating the environmental, social, and economic impacts of a hotel's operations to determine its sustainability performance [21,48,49].

- Green Certifications: Certifications such as Green Globe, LEED (Leadership in Energy and Environmental Design), and Earth Check that provide third-party validation of a hotel's environmental performance and commitment to sustainable practices (Chan & Hawkins, 2010) [50,51].
- Energy Management: Practices aimed at reducing energy consumption and enhancing energy efficiency through technologies such as smart thermostats, energy-efficient lighting, and renewable energy sources [52,53].
- Waste Management: Strategies to minimize waste generation and enhance waste recycling and disposal processes within hotel operations [24].
- Water Conservation: Measures to reduce water usage and promote efficient water management in hotel facilities, including low-flow fixtures, greywater systems, and water recycling [22].

3.2. Emergence and Application of Environmental Sustainability and Assessments Tools and Techniques in Hotels

Various researches exist that cover the aspect of environmental sustainability and its practice in the hotel business. Initial studies enlightened scholars on the factors that encourage or hinder sustainable practices [39,54] stated that regulatory pressures, cost reduction, and the corporate entity's image are key factors that can influence hotels toward environmental initiatives. Recent research by [55,56] support these findings, showing that regulatory compliance and cost savings are significant motivators for hotels to adopt green practices.

Other works focused on specific aspects of sustainability and their efficiency [36,37] conducted extensive research on high energy and water conservation practices in European hotels, discovering many potential cost-saving measures and environmental improvements. Similarly, a study by [4,11,50] confirmed that energy and water conservation are still critical areas for sustainability in hotels. [50] examined the effects of green certifications on the performance of the hotel industry, finding that certified hotels engaged in superior environmental management and increased marketability. A more recent study by [57,58] also found that green certifications significantly enhance a hotel's market position and operational performance.

Increased research focus has now been directed toward determining the global sustainability performance of hotels using total value assessment instruments. For example, [45,58] analyzed the environmental, social, and economic aspects of sustainability in Mediterranean hotels and obtained a comprehensive picture of the sustainability index of the hotels. Additionally, recent studies by [28,59] highlight the importance of integrating social and economic dimensions into sustainability assessments in the hospitality industry. [25,52] surveyed the usage of modern technologies like renewable energy sources and waste conversion technologies, thereby enhancing the efficient standards of sustainability performance. A recent review by [60] further emphasizes the role of innovative technologies in improving sustainability practices in the hospitality sector.

4. Descriptive Analysis

The overall systematic approach, the review intends to offer a reliable and comprehensive assessment of the practices concerning environmental sustainability assessment in the context of the hotel industry.

4.1. Emergence of Environmental Assessment Tools and Techniques in Hotels

The review identified several approaches and tools used for environmental sustainability assessment in hotels. Hotel classification has traditionally been a main component valued by potential guests, investors and other stakeholders capable of influencing their hotel selection. As the global market evolved and various challenges emerged, it is now becoming more relevant and important for hotel organizations to adopt an integrated approach towards sustainability. In addition

to having good ratings and classifications their approaches need to encompass quality management as well as proper evaluation of the environmental and ecological contributions of the hotels [61]. Such advancement will allow for a comprehensive understanding on the varied criteria related to environmental management and sustainability. Given the lack of compulsory or globally required environmentally sustainable criteria, several approaches and methodologies are reported as being used by varied hotel organizations [62,63]. They are categorized namely into five main types: developed conceptual directions, standards and measures, management models, index models and Evaluation/Selection models.

1. Established Guidelines: Others are such as the Global Reporting Initiative (GRI) and the International Integrated Reporting Council (IIRC). Of the three standards, GRI standards are the most popular, featuring the most elaborate global reporting guidelines especially for the hotel industry [64–66]. The IIRC is specifically concerned with integrated reporting which involves the provision of a well-coordinated report that blends both financial and non-financial information about an organization's sustainability performance.
2. Normative Frameworks: In this category, some tools include the United Nations Global Compact (UNGC) as well as the Sustainable Development Goals (SDGs). The UNGC is a portfolio of the ten principles concerning human rights, labour, environment and anti-corruption that offers direction to the hotels on the achievement of further sustainable development [67].
3. Management Systems: Management of environment is one of the many tools that has attracted recognition in the hotel industry; this includes EMS ISO 14001 and the EMAS. ISO 14001 offers the guidelines on environmental management standards while EMAS offers a higher level of standard with reporting to the public [37,68].
4. Index Systems: The indices includes the Dow Jones Sustainability Index (DJSI) and the FTSE4Good Index are often used to measure a hotel's level of sustainability. These indices measure and rank the firms on the environmental, social and governance elements, to assess the comparative sustainability worth of enterprises [69].
5. Rating/Ranking Systems: Indices like the Bloomberg ESG Data as well as the ISS-Oekom Corporate Rating rate the sustainability disclosures and performance of hotels. These systems enable investors and stakeholders to take better decisions in possibilities of a hotel regarding sustainability [70].

Hotels have frequently used frameworks and standards like the Global Reporting Initiative (GRI), the Sustainable Development Goals (SDGs), ISO 14001 for Environmental Management Systems (EMS), and other certifications in their quest for sustainability. Through standardised metrics, GRI, for instance, offers an organized method for reporting environmental, social, and governance (ESG) issues, improving transparency and building stakeholder trust among hotels and other organizations [71]. But putting GRI into practice hotels may find it resource-intensive among other challenges. Adopting SDGs or other normative frameworks provides a thorough worldwide framework that synchronises hotel operations with general societal objectives, encouraging cooperation and all-encompassing sustainable ways [72]. However, prioritization and measurement issues may arise when adapting the SDGs to various hotel environments, making successful implementation more difficult [73]. Hotel environmental performance is continuously improved and regulatory compliance is supported by EMS ISO 14001, which guarantees systematic environmental management [74]. However, smaller hotels might be discouraged from obtaining certification due to its expense and complexity, which would restrict its applicability and reach [74]. Environmentally concerned consumers can easily distinguish products and services from one another thanks to ratings and criteria such as Green Key, which also help with operational

enhancements and market distinction [75]. However, obtaining and retaining certifications can be expensive, and there is always a chance of greenwashing, which could damage the legitimacy of sustainability initiatives [75].

Several advantages and opportunities have been gained in hotels in developed and small island developing states from the adoption of sustainable guidelines, frameworks, rating and or standards. For instance when referring to the Sustainable Development Goals (SDGs) and the Global Reporting Initiative (GRI) which are well-established in developed nations for example it has been reported that they offer a well-structured approach towards improving environmental performance while harmonising same with responsible tourism practices. Adopting environmental approaches and practices as mentioned above, lead to better competitiveness of concerned hotels by attracting environmentally conscious investors and consumers [76]. Through other certification such as EMS ISO 14001, hotels may safely guarantee compliance as well as aim to maximise their operational efficiency as such efforts may lead to cost savings and enhanced processes [74]. By adopting all of the above it is important to highlight some related challenges that hotels may face such as a high upfront expense for implementation, institutional or organizational hurdles during implementation procedures which may specifically affect smaller hotels be it from developed countries or even hotels within developing island states.

As Small Island Developing States (SIDS) are recovering from the pandemic and other potential health-related or environmental challenges adoption of proper environmental sustainability approaches and methodologies can only enhance their competitive advantage. SIDS were among the quickest to recover their visitor numbers post-pandemic despite their insularity and other related challenges and they welcomed back 36 million foreign visitors in 2023 (+42% from 2022) as reported by [77]. The hotel sector of SIDS may greatly benefit from the adoption and proper implementation of above-mentioned sustainability guidelines, frameworks and certifications as they can be viewed as established practices that may alleviate potential environmental challenges faced by SIDS while ensuring that they align to the global environmental goals and targets.

4.2. Common Environmental Sustainability Assessment Methods

Different methods were adapted by the chosen studies to evaluate the sustainability criteria in the hotels. These techniques fall into four main categories: These techniques fall into four main categories:

1. **Criteria Weight Attribution:** [78] categorised the techniques into three, and out of the 11 studies, Multi-Criteria Decision Analysis (MCDA) dominated the approach. It is helpful in weighting the different aspects of sustainability so that an even scale of measurement is arrived at [21]. Such other approaches are DEA, WS, and Entropy.
2. **Sub-Criteria Grouping:** To achieve this, Principal Component Analysis (PCA) together with Factor Analysis (FA) are used in organizing the sub-criteria in groups with similarities to ease the assessment process. PCA was found to be especially used in six studies in the reduction of the dimensionality in sustainability data [22].
3. **Subjective Judgment Minimization:** Subjectivity of the expert assessments is reduced with Fuzzy Logic (FL) being used. This technique was identified in seven studies and it helps to increase the reliability of sustainability assessment by managing with imprecise and uncertain information.
4. **Dependency Determination:** Relation between several sustainability criteria is studied by the help of System Dynamics (SD) and helps to consider all the interconnections in the sustainability assessments [52].

5. Environmental Footprint such as carbon footprint or Ecological Footprint Analysis are other common methodologies employing specific techniques within the discourse surrounding the concept of "carrying capacity." [79,80].

Referring to previously discussed environmental tools and approaches and inline to the above mentioned criteria that is in use within hotels, additional benefits may emerge for hotels within SIDS [80]. On a whole several targets and goals may be achieved by adopting the environmental approaches and tools. For instance it sets the ground for hotels to work towards improved environmental performance, increased hotel operations efficiency, global compliance to international sustainability best practices [82]. This will not only be a marketing and competitive advantage among eco-aware tourists but also open avenues for more collaboration and investment opportunities further sustaining the practice of sustainable tourism on the islands. Islands destinations bearing a limited geographical area dependent on natural resources will heavily benefit from adopting sustainability, which can increase resilience to environmental vulnerabilities and the effects of climate change.

Sustainable practices can be promoted by the implementation of environmental tools and approaches as they will contribute to further use of renewable energy, waste minimization, and water conservation among others which can aid SIDS prevent environmental degradation and improve their resilience to shocks from the environment to name a few [83]. The additional benefit of environmental sustainability techniques and practices will aid developing islands build a strong institutionalisation of sustainability by incorporating the same within local policy frameworks and regulations providing an opportunity for proper governance, environmental stewardship and meeting the overall goal of sustainable development which remains their priority.

4.3. Environmental Sustainability Assessment: Contributions to the Dimensions of Sustainability

The studies predominantly focused on the three main pillars of sustainability: The respective environmental, social, and economic personal factors and regulated business contexts. The environmental dimension was the most frequently assessed dimension followed by the social dimension and then the economic dimension, with the number 37, 34, and 31 studies respectively. As for the assessment of governance and the financials aspects, these were reported less often although they sometimes fell under all-encompassing measurements [45].

Environmental Dimension: These include energy conservation which is obtaining energy most efficiently and cleanly practicable, water conservation, and waste minimization which is getting rid of waste in the least amount possible and reduction of greenhouse gas emissions [15,37].

Social Dimension: This is about the relationship and cohesiveness among all stakeholders of the hotel from human resources, community and customers. The social dimension helps showcase the organization's social responsiveness and effects. [84] further adds that such practices may foster the goodwill and reputation of the organization as while focusing on social aspects of sustainability within its operations it further aids to welcome and retain customers who are for socially responsible practices.

Economic Dimension: The adoption of social and environmental sustainability practices not only financially contributes to hotel revenues but it also attracts specific customers willing to pay more to stay in environmentally sustainable hotels [85]. For instance, by paying attention on financial returns such as energy savings, cost reductions from implementing sustainability and the revenues contribute other benefits such as better organizational image [86].

4.4. Industry Specific Strategies

Environmental sustainability has been an area of research and planning interest among various sectors, more so within the hotel sector over the years for various reasons. Hotels' intensive resource consumption, environmental impacts and carbon emissions can be addressed through the right sustainability approaches and methodologies leading to an overall lower ecological hotel sector

footprint [87]. Such initiatives will additionally contribute to the global efforts towards addressing environmental deterioration and climate related challenges.

The findings evidencing the hotel industry reveal that the implementation of sustainability strategies in the hotel sector differs from one geographical location to another and from one type of hotel to another. Several works used their findings to confirm that European and Asian hotels are more progressive in overall sustainability evaluation compared to hotels located in other regions of the world [45,59,88]. More comprehensive sustainability solutions are also implemented by luxury hotels due to legal obligations and to meet customers' expectations for more eco-friendly hotels [50].

Energy Management: Most hotels in Europe, particularly those in the Mediterranean, have enhanced the efficient use of energy by adopting renewable energy and energy-efficient products and services [37] and these may extensively benefit the hotel sector more so among small island developing states. Recent studies show that these measures significantly contribute to reducing the overall carbon footprint of hotels [11,73]. Through energy management hotels from various destinations and those within island states, can relieve their reliance on fossil fuel use and make the shift to more clean sources of energy. Such advancements may additionally lead to other operational benefits as hotels may face reduced fluctuations attached to several supply disruptions like fuel prices [81,89].

Water Conservation: [22] explains that many hotels in water-scarce areas, especially in the Middle East and North Africa, have developed technological methods and water recycling mechanisms to optimize water use in their accommodation services. These practices not only conserve water but also reduce the environmental footprint associated with water consumption [90,91]. Adopting environmentally friendly practices such as water conservation programs hotel establishments can appeal better to eco-conscious guests thus contributing to their overall sustainability. Given that sustainability is a top priority of many travellers, through the right tools and approaches to contribute to water conservation, hotels can further show their environmental commitment and responsibility which in turn contribute to enhancing reputation, more rooms sold and revenues [92].

Waste Management: The analyzed hotels in Asia, particularly those located in large cities, have implemented complex waste reduction strategies and have begun using waste-to-energy technologies [24]. This approach not only manages waste more effectively but also reduces greenhouse gas emissions by converting waste into energy [93]. [94] Proper waste management programs and initiatives contribute to significant benefits in hotels whether in big cities as researched in Asia or within small island states where there are already waste disposal and storage challenges. Through proper waste management initiatives hotels within small island developing states may similarly to Asian and European countries as per previous studies efficiently manage their wastes, manage their environmental impacts as well as manage their waste disposal [95]. Through the implementation of waste management programs, composting initiatives, and reduced greenhouse gas emissions, hotels may work towards reducing their overall amount of waste to landfills as well as adopt cleaner environments, devise more sustainable energy production as well as develop healthier ecosystems.

Environmental Assessment: Environmental assessments are increasingly being used to measure and reduce the overall carbon footprint of hotels. By evaluating their environmental impact, hotels can implement targeted strategies to minimize energy use, manage waste, and conserve water, thereby reducing their overall environmental footprint [40]. These assessments are crucial for developing long-term sustainability plans that align with global sustainability goals [43]. Through proper environmental assessments, hotels may better understand their resource consumption and related environmental impacts that may contribute to enhanced hotel sustainability [96]. Adopting the right proactive approaches may additionally lead to an overall reduced hotel operational costs and contribute to the overall environmental degradation of island states.

5. Discussion

The overall findings from the retained review papers underscore the critical role of systematic environmental assessments in driving sustainability in the hotel industry. By adopting comprehensive and reliable tools and methodologies, hotels can significantly enhance their environmental performance, meet regulatory requirements, and satisfy the growing demand from consumers for eco-friendly accommodations. By implementing environmental tools, hotels may comply with regulations and maintain worldwide standards and best practices. A growing number of tiny island nations are putting laws and policies into place that support renewable energy and lower carbon emissions [97]. In addition to abiding with local regulations, hotels that take the initiative to implement these measures also establish themselves as pioneers in sustainable tourism, improving their standing and ability to compete on the international scene.

The findings of this systematic review highlight the growing importance of environmental sustainability assessment in the hotel industry. Over the past decade, there has been a significant increase in publications on this topic, indicating that sustainability issues are being increasingly acknowledged by hotel managers, scholars, and governments [98–100]. This global concern and collaboration to tackle environmental problems in the hospitality industry are evidenced by research conducted across diverse geographical regions [45] for instance. By embracing sustainability, hotels within small island states, may lessen their negative effects on the environment and establish themselves as leaders of sustainable development in both their local communities and international travel markets.

One key finding is the variety of strategies and instruments used for sustainability assessment, including guidelines, standards, norms, management systems, index systems, and rating/ranking systems. The review reveals a predominant focus on environmental aspects, which is understandable given the immediate and tangible impacts of hotel operations on the environment. The use and implementation of environmental assessment tools and approaches and its contributions to environmental sustainability have improved the reliability of sustainability assessments by systematically identifying and aggregating various criteria and their related weightings [101]. Such methodologies are particularly relevant to the triple bottom-line approach, which considers environmental, social, and economic aspects of sustainability [41]. In addition to traditional methods, other tools such as Ecological Footprint and carbon footprint analysis have gained traction in recent years. These tools offer quantifiable measures of the environmental impact of hotels, enabling more precise and actionable sustainability strategies [60]. For instance, Ecological Footprint analysis helps hotels understand the extent of their resource consumption and waste generation relative to the Earth's capacity to regenerate those resources [102]. Carbon footprint analysis, on the other hand, allows hotels to track and reduce their greenhouse gas emissions, thereby contributing to global efforts to combat climate change [52].

Additionally, it can be noted that by establishing connections with regional providers for instance for renewable energy technologies and services, waste management initiatives or even water conservation programs, several benefits can be achieved [56]. For instance, it may lead to opening doors for green jobs which can boost local economies. In small island states, this economic diversification promotes a more sustainable and inclusive tourism industry by lowering reliance on traditional tourism earnings.

To optimise the advantages of potential positive environmental sustainability achievements all stakeholders within the hotel industry namely the governments, businesses in the private sector, international organisations or non-governmental organisations, and local communities must all work together to remove these obstacles and realise the full potential of sustainable practices in small island state hotel industries [103]. The adoption of environmental technologies in these settings can also be very useful as very often there may be issues such as upfront investment costs, lack of technical know-how, and legal frameworks which are specific to island contexts that must be resolved. In conclusion, hotels in tiny island nations can benefit greatly from environmental tools and techniques that are modelled after successful European models. These benefits include cost reductions, improved market appeal, regulatory compliance, and economic diversification.

5.1. Implications for Practice

The implications of these findings are, therefore, far-reaching to the management of hotels and policymakers. Consequently, hotel managers that implement the best practices of the assessment tools and techniques highlighted above, increase sustainability strategies, encourage the enhancement of organizational procedures, and promote overall marketability. Such approaches as ISO 14001 and GRI standards can be useful as hotels can use those to provide a structured environmental management system, obey legislation and respond to the demands of guests concerning sustainability [44].

This review also reveals that proper implementation and use of environmental sustainability assessment and tools require focus on various aspects such as human capital, access and affordability of technologies, customer choices and their related consumption patterns and behaviours, and related national policies and strategies among others. As supported by [73], implementing sustainability tools requires relevant expertise. The implementation of environmental sustainability approaches and methodologies often requires investment in advanced technologies. Access to the best technologies known to contribute to an overall positive sustainability agenda can be a barrier to small hotels whether in well-established destinations or even more in hotels operating within Small Island Developing States (SIDS) [104]. Hotel industry stakeholders as discussed by [105] are often required to align with national policies and strategies. For instance, regulatory frameworks and institutions need to provide the right incentives and facilitate the implementation of environmentally sustainable practices within the hotel sector. Decision-makers can therefore apply these recommendations when framing legislation and providing incentives that would act as props for sustainable management in the hotel business. Through the promotion and framing of standard working structures, the authorities can work towards general positive changes and guarantee that hotels have a positive impact on the conservation of the environment. Furthermore, the rise of the overall approach to policy sustainability assessment regarding the social and economic concerned can assist politicians in defining adequate and fair policy concerning the sustainable development.

Concerning the above-mentioned there are also customer preferences and their behavioural intention that play a crucial role in the effective assessment of environmental sustainability within a hotel. It is worth highlighting as described by [106] that expecting the same environmental habits from a customer's household to a particular hotel setting can be challenging despite the individuals being typically much involved at their home in environmental practices. Along the same thought, it can be said that hotels despite having a very rigid and well-implemented environmental sustainability plan and agenda may be influenced by the attitudes and behaviours of their guests.

5.2. Limitations

This systematic review has the following limitations: Firstly, it might be indicated that, because the studies were selected from published sources, the publication bias might occur as a result of the fact that only the positive studies get published. This could lead to an overestimate of some practices regarding sustainability resulting in poor strategy formulation. Secondly, based on the scope of the English language, the researcher was limited in the ability to access articles written in other languages, which might have resulted in leaving out important regional findings.

A major constraint for hotels in both developed and developing island states is the difficulty associated with human capital, may in turn entail a related training and development expenditure. Along the same line, hotels might find it hard to distribute their human resource adequately [107]. Hotels frequently require significant investments in enhancing the skills of their employees to ensure the successful implementation and maintenance of sustainable practices. Smaller hotels or those with restricted resources may find this cost load particularly overwhelming [108]. In addition, hotels may face challenges in effectively allocating their human resources, especially in isolated island destinations where there is a shortage of competent workers. The challenge of ensuring a skilled and evenly distributed staff might hinder the constant implementation of sustainability measures, hence impacting the overall efficacy of these endeavours [109].

Despite the long-term benefits that hotels may enjoy from the initial investment costs are often a challenge for hotels operating within a competitive environment or if they face budgetary constraints. It is worth being reminded as supported by [110] that such constraints may be more pronounced in both developed and developing island states, where the high cost of sustainable technologies and practices can deter hotels from adopting them. Consequently, the inability to invest upfront may delay the overall progress and efforts towards sustainability within the hotel sector.

Regulations and policies at the national level have also been reported as having a substantial impact on the adoption of sustainable practices in hotels, either by supporting or hindering their implementation. Lackluster or inconsistent policies may be insufficient in motivating hotels to implement sustainable practices, or even worse, may deter them from doing so. An important research constraint for hotels in both developed and developing island nations is the variation in policy contexts. This leads to inconsistent implementation of sustainability practices and makes it difficult to establish industry-wide standards [111,112].

The promotion of Pro-Environmental Behaviours (PEB) is another aspect that hotel operators may need to focus on as PEB aligns with the broader goal of engaging and empowering guests in sustainable practices [113]. Encouraging guests to actively participate in sustainable behaviours will not only enhance the guests' overall hotel experience but also foster a sense of responsibility and environmental consciousness as re-iterated by [114]. Accordingly, despite some guests being concerned and environmentally conscious options, other guests may be indifferent or even opt for less sustainable choices. Hence despite the presence and implementation of very good environmental sustainability approaches and measures in place, it is imperative to further investigate the factors that may contribute to such guests' behaviours hence making it more feasible for the successful engagement of every stakeholder from the hotel owners, managers, policy makers and more importantly the guests.

Moreover, the approaches and settings of the identified studies are diverse which makes comparison difficult. It also becomes even more complicated to synthesise findings due to the variety of geographical locations, hotel chains and operation sizes. Finally, it is essential to note that despite examining the current approaches, the review has not established a detailed investigation of the sustainability programs' enduring results, which necessitates research with long-term follow-up periods. Some of these limitations could be avoided in subsequent studies to have a more comprehensive view of environmental sustainability in the hotel industry. Specific strategies such as follow-up studies, inclusion of multiple languages, and studies from less explored areas can improve the transferability of the results.

6. Conclusions and Recommendations

6.1. Summary of Findings

Stemming from this research question, this systematic review elicited information on the strategies, instruments, and methods for assessing ESAs in the hotel business. The analysis of 38 selected studies revealed several key findings: The analysis of 38 selected studies revealed several key findings:

1. Increasing Research Interest: In the last decade, a significant improvement has been realized in the study of environmental sustainability in hotels and this has been precipitated by increasing international consciousness as well as legislation on the matter.
2. Diverse Geographic Coverage: Research areas were dissimilar, and the most common regions were European and Asian. This shows a trend of wanting an upgrade of sustainability practices within the hospitality industry across the world.
3. Adoption of Established Frameworks: Two guidelines that were found to be in extensive use for sustainability reporting were the GRI and the ISO 14001 which gave systematic ways for the assessment of sustainability.

4. Comprehensive Assessment Techniques: Others included: It was observed that tools such as the Multi-Criteria Decision Analysis (MCDA), Principal Component Analysis (PCA), and Fuzzy Logic were often employed to increase the credibility of sustainability evaluations.

6.2. Recommendations for Future Research

Based on the gaps identified in the current literature, the following recommendations are proposed for future research: Based on the gaps identified in the current literature, the following recommendations are proposed for future research:

1. Standardization of Methodologies: Further empirical studies should be directed toward the creation and testing of frameworks on sustainability report with generic tools suitable for different geographical locations and categories of hotels. This would improve the standards of comparability and reliability of the assessments being made.
2. Integration of Social and Economic Dimensions: Sustainability check & evaluations are still insufficient and economic aspects should be included together with social aspects. This would afford an integrated perspective of the firm's sustainability performance, and realize compatibility, redundancy, or rivalry between sustainability strategies.
3. Longitudinal Studies: More researches have to be conducted to examine the changes in the sustainability performance of hotels during different periods. This would give an understanding about the effects that sustainability endeavours would have in the future and the aspects that would lead to a continuity in the advancements.
4. Emerging Technologies: Future studies should investigate how the new technologies of blockchain, artificial intelligence, the IoT in the hospitality industry regarding the promotion of sustainability practices and their impact. Such advancements offer great opportunities towards enhancing operational efficiency, sound consumption patterns, reduced emissions and improved data transparency, all necessary criteria to foster sustainable hotel management. By studying how the integration of such innovations may render the hotel sector more environmentally sustainable, research can provide valuable findings contributing to the practical applications and benefits. These may in turn guide hotels in both developed and developing island states towards more effective sustainability strategies
5. It can be further recommended that other research works further gear their investigation towards pro-environmental behaviours and the use of behavioural analysis to gain a deeper understanding of how to effectively promote sustainable habits among hotel guests and personnel. Hotels are reported to be capable of enhancing sustainability by understanding the determinants of eco-friendly behaviours and implementing focused interventions and educational initiatives. This method can facilitate the customisation of tactics to diverse cultural and economic situations, hence enhancing their efficacy in both developed and developing island states. By comprehending behavioural patterns, hotels may create more captivating and convincing sustainability programmes, hence promoting a more ecologically aware hospitality business [106].
6. Regional and Cultural Variations: Studies that examine regional and cultural variations in sustainability practices and their effectiveness would provide valuable insights for tailoring sustainability initiatives to specific contexts.

6.3. Final Thoughts

The hotel industry plays a crucial role in the global economy, serving millions of tourists and business travelers annually and significantly contributing to employment and GDP in many countries. This paper stresses the growing significance of evaluating environmental impacts within the hotel business. Adopting best practices and a set of measurement criteria can help hotels promote sustainable development. Sophisticated assessment instruments and methods are beneficial as they can minimize pollution output, appeal to environmentally conscious clients, enhance the hotel’s image, and save costs through efficient operations.

Policymakers also have a significant influence on sustainability initiatives by implementing specific regulations and offering relevant incentives to encourage sustainability. Governments can drive industry-wide change by setting stringent environmental standards and providing financial support for green initiatives. As the hotel industry continues to grow, the concept of sustainability must be integral to developmental strategies to ensure long-term success and resilience.

The findings of this review offer an opportunity for further research and practice, supporting the development of a sustainable and resilient hospitality industry. By fostering collaboration between industry stakeholders and policymakers, the sector can achieve substantial environmental benefits and ensure sustainable growth.

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Appendix A: Summary of Sample selected Studies

Study	Year	Geographic Region	Type of Document	Sustainability Approach	Key Findings
Bohdanowicz, P.	2005	Europe	Journal Article	ISO 14001, EMS	Identified significant potential for energy and water conservation in European hotels.
Chan, E. S. W., & Hawkins, R.	2010	Global	Journal Article	EMS, Green Certifications	Highlighted the positive impact of green certifications on hotel performance and marketability.
Jones, P., Hillier, D., & Comfort, D.	2014	Global	Journal Article	GRI, SDGs	Discussed the adoption of GRI and SDGs in the global

						hotel industry and their effectiveness.
Kirk, D.	1995	Europe	Journal Article	Basic Environmental Management Practices		Early study on initial steps taken by hotels towards sustainability, focusing on recycling and energy conservation.
Leonidou, L. C., et al.	2013	Mediterranean	Journal Article	Integrated Assessment Tools		Evaluated the environmental, social, and economic dimensions of sustainability in Mediterranean hotels.
Mensah, I.	2006	Africa	Journal Article	EMS		Examined environmental management practices in hotels in the Greater Accra region, identifying key drivers and barriers.
Pirani, S. I., & Arafat, H. A.	2014	Asia	Journal Article	Waste Management Systems		Reviewed solid waste management practices in the hospitality industry, highlighting advanced technologies in urban hotels.
Siew, R. Y. J.	2015	China	Journal Article	GRI, Corporate Sustainability Reporting Tools		Assessed and reported on environmental sustainability in two hotels in China.

Appendix B: Data Extraction Form

Study ID	Authors	Year	Geographic Region	Study Design	Sample Size	Sustainability Approach	Key Findings
1	Bohdanowicz, P.	2005	Europe	Cross-sectional	50 hotels	ISO 14001, EMS	Energy and water conservation potential.
2	Chan, E. S. W., & Hawkins, R.	2010	Global	Case Study	30 hotels	EMS, Green Certifications	Positive impact on performance.
3	Jones, P., Hillier, D., & Comfort, D.	2014	Global	Review	Not applicable	GRI, SDGs	Adoption and effectiveness of GRI and SDGs.
4	Kirk, D.	1995	Europe	Survey	40 hotels	Basic Practices	Initial steps towards sustainability.
5	Leonidou, L. C., et al.	2013	Mediterranean	Quantitative	60 hotels	Integrated Tools	Evaluated sustainability dimensions.

6	Mensah, I.	2006	Africa	Survey	35 hotels	EMS	Environmental management practices.
7	Pirani, S. I., & Arafat, H. A.	2014	Asia	Review	Not applicable	Waste Management	Advanced technologies in urban hotels.
8	Siew, R. Y. J.	2015a	China	Case Study	2 hotels	GRI, Reporting Tools	Environmental sustainability reporting.

Appendix D: Detailed Tables and Charts

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