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Short Paper

Artificial Intelligence in Sustainable Tourism- Advance Efficiency and Resource Management in Hospitality

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Abstract

Purpose – This study explores how artificial intelligence (AI) can promote sustainable tourism, specifically in the areas of resource management and efficiency in the hospitality industry, while addressing related socioeconomic and environmental issues.

Method – This study uses a mixed-methods approach to examine how AI applications, such as predictive analytics, energy management systems, smart technologies, and AI-

based tools, can optimize resources, improve energy efficiency, and increase visitor engagement in the hospitality industry. It does this by methodically reviewing industry reports, scholarly sources, and social media content.

Results – According to the findings, AI-driven solutions greatly promote sustainable tourism by reducing waste, increasing operational and energy efficiency, and encouraging responsible consumption and climate action. This is particularly in line with Sustainable Development Goals (SDGs) like Clean Energy (SDG 7), Responsible Consumption (SDG 12), and Climate Action (SDG 13). However, obstacles like algorithmic bias, high implementation costs, and data privacy issues prevent AI technologies from being widely adopted in the industry.

Conclusion – AI is essential to achieving sustainability goals and improving operational efficiency in the hospitality sector. To fully realize AI's potential for environmental and socioeconomic advancement in tourism, broader adoption, uniform sustainability metrics, and ethical frameworks are necessary.

Recommendation – The goals of future research should be to create standardized frameworks for sustainability assessments, create scalable and reasonably priced AI solutions for SMEs, and investigate the ethical and industry-specific ramifications of AI use in sustainable tourism.

Research Implications – By highlighting areas for further research, especially in the scaling and equitable implementation of AI technologies within the industry, this article enhances the body of knowledge on AI's contributions to sustainable tourism and hospitality.

Keywords – Artificial Intelligence in Tourism, Sustainable Tourism, Hospitality Sector Efficiency, Resource Optimization, Sustainable Development Goals (SDGs)

INTRODUCTION

Artificial Intelligence (AI) is a transformational set of tools and methods for addressing some of the environmental survivability as well as socio-economic equity challenges in hospitality and tourism, as it relates to sustainable tourism through optimizing resources. Tourism, one of the world's largest industries, is a major driver of economic growth but also a source of environmental and cultural degradation. That duality needs exploration of new tools like AI that can balance the competing imperatives of growth and sustainability. Frequently dubbed a "smoke-free industry," tourism has exploded into a cornerstone of global economic activity, generating $1.7 trillion in 2019 receipts (UNWTO, 2020). Nonetheless, despite its economic contribution and as a responsible catalyst for global development, the industry has been widely

criticized for its environmental impact, which is manifested in over-tourism, resource depletion, and erosion of the culture (Gössling & Peeters, 2015; Rasel, 2024). Sustainable tourism, defined as the effort of minimizing the negative environmental impacts while maximizing the socio-economic benefits, has opened opportunities to counteract these challenges. The sequence of analytical, cognitive, and predictive capabilities put forward by AI is a handy way to sail through resource usage, operational efficiency, and visitor experience improvements for sustainability (Majid et al., 2022; Tussyadiah, 2020).

Many scholars have discussed the potential implementation of AI in tourism and sustainability. Artificial intelligence, which can process data in the form of large algorithms in a shorter time than humans, has shown promising applications in predictive analytics, machine learning, and natural language processing that are extremely beneficial to energy efficiency, waste management, and personalized visitor experiences (Rane et al., 2024; Louati et al., 2024). In the background, AI-based energy management systems in hospitality efficiently reduce energy consumption (Rasel, 2024). Additionally, AI-driven recommendation engines and virtual assistants have improved visitor satisfaction, while also encouraging environmentally conscious travel practices (Kim et al., 2018; Majid et al., 2023). Yet, the implementation of AI in tourism is not devoid of implications, which are algorithmic bias, technology implementation costs, and data privacy issues (Ivanov & Webster, 2019; Roxas et al., 2020).

The term "smart tourism" has broadened the scope of potential AI use cases. Smart tourism seamlessly combines physical and digital resources through a combination of IoT, cloud computing, and augmented reality (AR) technologies to provide improved experiences while also fostering sustainable development (Li et al., 2022; Rane et al., 2024). For example, AR applications can add to long-term cultural and historical stories, enhancing the value of treasuring heritage places without putting harmful pressure on sensitive sites (Santos et al., 2021). Despite showing great promise in promoting sustainable tourism practices, the uptake of AI remains patchy due to economic and technological barriers, and a lack of standardized methodologies to measure sustainability results (Liu, 2003; UNEP & UNWTO, 2005). Moreover, the tourism sector's sensitivity to crises, like the COVID-19 pandemic, highlights the importance of resilient and adaptive systems within the field (Louati et al., 2024). Rectifying these gaps is critical to ensure that AI provides not just immediate operational efficiencies, but also future sustainability aims.

This study aims to give an overview of current applications of AI in the field of sustainable tourism, specifically in energy efficiency, resource management, and visitor engagement. Understand some of the challenges and barriers to AI taking off in the tourism and hospitality sectors. Establish a thought model for implementing AI in eco-friendly tourism initiatives, in accordance with the Sustainable Development Goals (SDGs). Assess the social, economic, and environmental impacts of AI-based tourism programs.

Research Questions

a) What are the key applications of AI in sustainable tourism and hospitality?
b) In what ways can AI technologies improve operational efficiency while enhancing visitors' experiences and minimizing environmental impacts?
c) What are the most significant challenges for the use of AI in sustainable tourism?

METHODOLOGY

Data Collection

This research follows a mixed-method approach, both qualitative and quantitative research methodologies, to explore Artificial Intelligence (AI) for sustainable tourism and hospitality. The study also highlights how AI is being leveraged to drive strategies that aim to minimize waste and resource use across various industries. Additionally, it allows for an all-encompassing understanding of the empirical data collected, and the body of theory nerds comes together.

Data for this study were obtained from various sources. Analyzed data from social media sites, including Twitter and LinkedIn , with NodeXL software. It offered valuable information about the discussions that are trending, the words that are being used in the context of AI in sustainable tourism, and how the actors were networked. Data used from UNWTO (United Nations World Tourism Organization) and UNEP websites (Table 1). The SDGs and their corresponding alignment with AI applications were gleaned from reliable sources. Reviewed literature using Google Scholar for known research and case studies. Examined industry reports published by major hospitality organizations. Research development trend of keywords (2015-2023) using online databases to demonstrate expressions such as “Artificial Intelligence,” “Sustainable Tourism,” and "Resource Management."

Data Analysis

Visual network maps were generated using NodeXL software, which indicated the relationship between fundamental terms such as "Artificial Intelligence," "Resource Optimization," and "Energy Efficiency." The maps showed groups of discussions and core players in the field. To analyze data, we used pie charts, bar graphs, and trend lines depicting focus areas of AI, projected market size (2022-2033), alignment of AI with SDGs (Sustainable Development Goals), and eco-friendly AI solutions. The growth rate of artificial intelligence technologies in hospitality has been computed by conducting descriptive statistical analysis. Data from UNWTO and UNEP reports were analyzed to obtain an idea of AI 's strategic alignment with the 17 SDGs (Table 1). Reviewed case studies and academic research to suggest best practices.

Table 1. Summary of 17 aims for the sustainable tourism agenda in 2030 by UNWTO.

Serial No	Aims	Key point of sustainable tourism development
1	No Poverty	Poverty reduction, tourism development, and community empowerment.
2	Zero Hunger	Infrastructure development, agritourism benefits
3	Good Health and Well-Being	Economic recovery, health and hygiene, and consumer confidence.
4	Quality Education	Workforce development, skill enhancement
5	Gender Equality	Women empowerment, entrepreneurship, women empowerment.
6	Clean Water and Sanitation	Water security, wastewater management, and sustainable tourism practices.
7	Affordable and Clean Energy	Renewable energy, energy efficiency, and climate change mitigation.
8	Decent Work and Economic Growth	Economic growth, job creation, and cultural preservation.
9	Industry, Innovation and Infrastructure	Infrastructure development, sustainable innovation, and carbon growth.
10	Reduced Inequalities	Economic integration, poverty reduction, and rural development.
11	Sustainable Cities and Communities	Urban infrastructure, cultural preservation, and green cities.
12	Responsible Consumption	Sustainable consumption and production, resource optimization, and environmental impact reduction.
13	Climate Action	Climate mitigation, carbon footprint reduction, and carbon growth.
14	Life Below Water	Marine ecosystem conservation, blue economy, sustainable marine resource use.
15	Life on Land	Biodiversity conservation, community welfare, and sustainable tourism development.
16	Peace and Justice	Cultural tolerance, human rights advocacy, and public security management.
17	Partnerships for the Goals	Public-private partnership, stakeholder engagement, innovative financing.

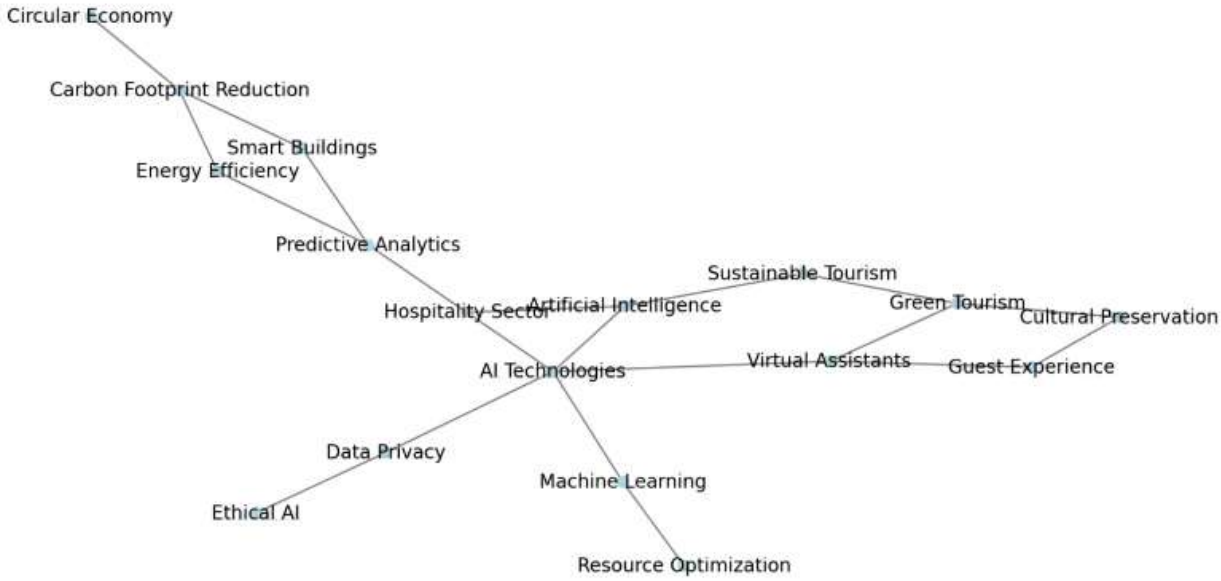

Figure 1. AI Applications in Sustainable Tourism and Hospitality

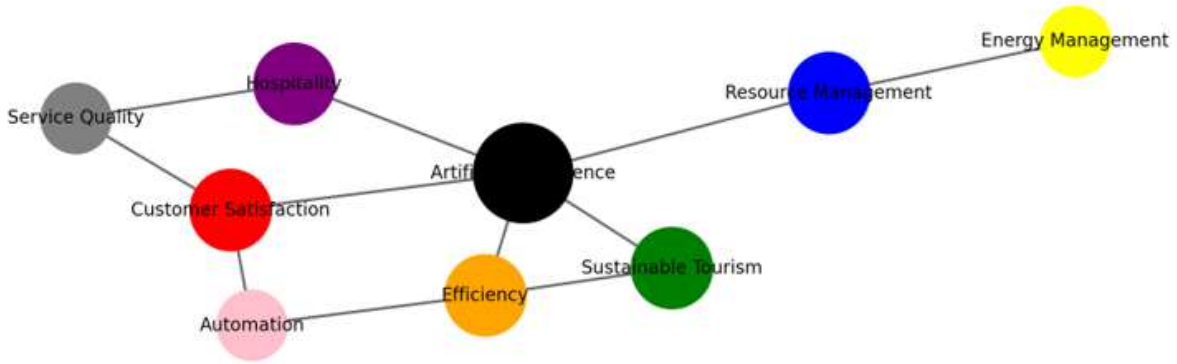

Figure 2. Network Analysis: AI in Sustainable Tourism

However, the data from social media might not cover every stakeholder in the hospitality sector. Some reports within the industry could not be accessed because they required subscriptions. These are based on available data and may not apply uniformly across all regions or sections of hospitality. This study focuses on AI technologies and does not cover emerging technologies such as blockchain, but it does not extensively cover emerging engineered technologies such as blockchain or Internet of Things (IoT). All except the trend analysis of keywords are limited to the period 2015-2023, which surely misses recent developments.

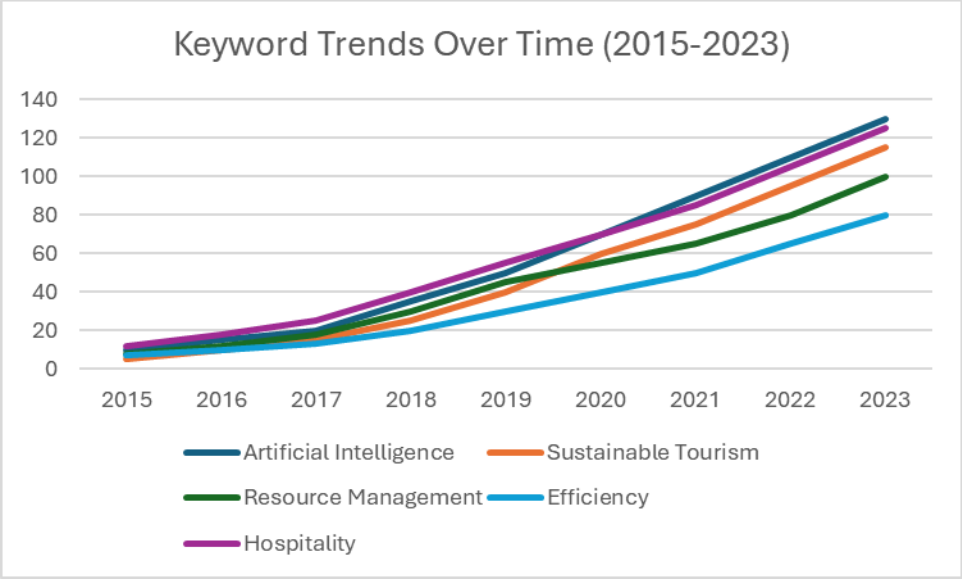

Figure 3. Incorporation of Sustainability Metrics

Incorporation of Sustainability Metrics

The analysis incorporated sustainability metrics provided in frameworks derived from the United Nations World Tourism Organization (UNWTO) and the United Nations Environment Program (UNEP) to align the research with the wider objectives of sustainable tourism. Applications of Artificial Intelligence (AI) in the hospitality sector were mapped against the 17 Sustainable Development Goals (SDGs) outlined in the 2030 Agenda. The mapping emphasized core dimensions like resource efficiency and energy optimization along with stakeholder engagement, which is pivotal in sustainable practices (UNWTO, 2018; UNEP, 2016). Metrics, particularly "Decent Work and Economic Growth" (SDG 8), "Affordable and Clean Energy" (SDG 7), and "Life on Land" (SDG 15), were examined through the lens of AI's potential for operational efficiency and improved sustainability (Buhalis & Sinarta, 2019).

This analysis comprised a cross-referencing of AI technologies from resource optimization to energy management systems, with their potential ability to impact these SDGs. The social network analysis approach allowed a real-time monitoring possibility by visualizing social media networks to identify clusters of discussions linking specific sustainability goals to AI (Hansen et al., 2010). To emphasize this point, AI applications were associated with terms like energy efficiency and sustainable tourism, confirming their significance in this sector (Koo et al., 2021).

Academic papers and industry reports have also backed this approach. Gössling and Hall (2019) also found that technology is crucial to attain sustainability within tourism, arguing that AI power can play a role in minimizing adaptive footprints via predictive analytics and resource management. Morabito et al. (2024), AI matches not

only the local but also the global sustainability agenda as it can enhance the decision-making and execution of policies within tourism and hospitality.
Particularly, the incorporation of sustainability metrics further provided a strong framework for measuring the real-world implications of AI technologies. By combining these metrics with quantitative data (e.g., market size projections, keyword trends), the study connects theoretical sustainability frameworks to empirical data. Although this approach gives a broad overview of the AI contribution for the SDGs, it has limitations, such as the inability to adequately account for local and contextual differences in AI use, as well as the caveat set by the data itself, as essentially it focused on internet data, which do not display the perspective of those without access to technology (Xu et al., 2021). The interdisciplinary insight provided by this approach shows how AI can facilitate sustainable tourism objectives, encourage a thoughtful consideration of AI in its practical applications within a hospitality context, and represent an essential focus for future research and development activities.

RESULTS

Artificial Intelligence (AI) has been increasingly adopted by the hospitality industry for sustainability and resource management. This research examines the role of AI in shaping sustainable tourism through its applications that encapsulate ethical, stakeholder, energy, and resource optimization. Focusing on AI's effectiveness for accomplishing these Sustainable Development Goals (SDGs), this paper discusses the implications of artificial intelligence in shaping the tourism sector with an innovative and green transition. AI is the hospitality sector for entrenched growth (Figure 5). The trend is anticipated to reach close to USD 81 billion by 2033. This growth underscores the growing acceptance of AI technologies in this field, spurred by the demand for efficient resource management and sustainable practices. (Figure 4) Illustrates the categorization of AI applications in sustainable hospitality into four primary categories. Firstly, ethical issues (10%) refer to the sense of responsibility towards the fair usage of AI. Secondly, stakeholder engagement (20%) encompasses the tools and interfaces for enhanced coordination and mutual communication. Thirdly, energy efficiency (40%) AI techniques can reduce energy consumption through various predictive algorithms. Fourthly, resource optimization (30%) tools that strive to ensure effective execution of processes whilst generating minimal waste.

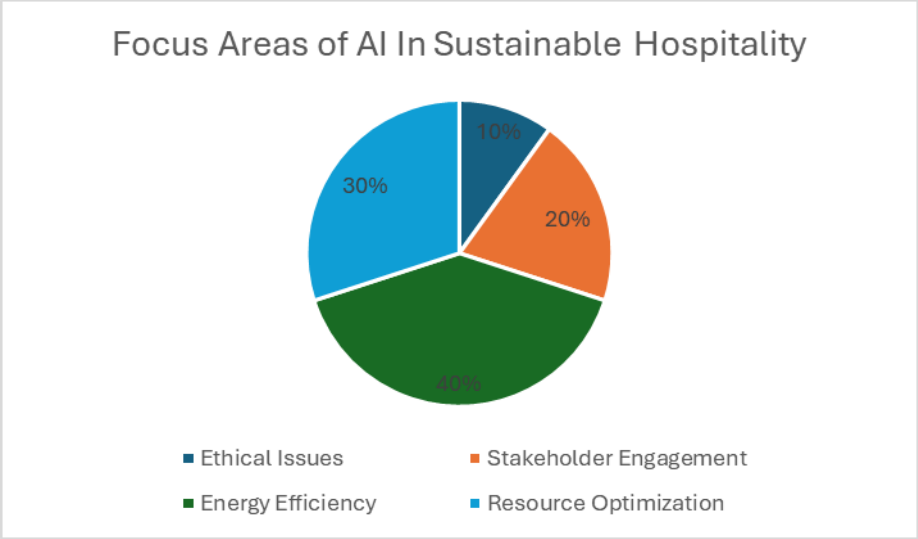

Figure 4. Categorization of AI Applications in Sustainable Hospitality

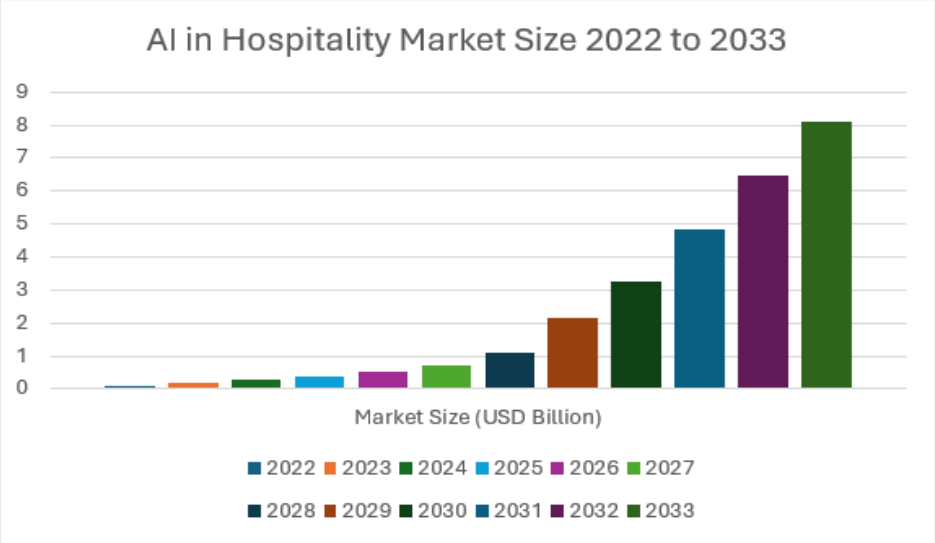

Figure 5. AI Growth in the Hospitality Sector

The data shows that energy saving and resource efficiency are two of the main goals for AI deployment. An SDG volume impact score (0-10) based analysis of AI gives relevant SDGs scores as Clean Energy (10), Decent Work (8), Reduced Inequalities (7), Good Health (6), making way for sustainability with Clean Energy leading the list (Figure 6). As shown in Figure 7, the top sustainability dimensions addressed by AI applications are Decent Work (41%), which focuses on the optimization of labor processes, Good Health (32%), which improves health management in the hospitality industry, and Life on Land (27%), which supports the conservation of natural resources and biodiversity. As a whole, these findings highlight AI's essential role in hospitality sustainability. Information on the findings is displayed using relevant graphs such as bar graphs, pie graphs, and

impact scores to concisely convey the information. Each figure provides a concise overview of AI's role in potential sustainable tourism and hospitality services. AI technology incorporated in the hospitality sector shows promising potential for sustainability. AI aids the sector's commitment to worldwide sustainability targets when it comes to using energy responsibly, ethically, and optimally. The hospitality sector is witnessing a shift towards AI as it becomes integrated into core business operations, helping to create a sustainable and resilient ecosystem for the future as the market for these innovative technologies continues to flourish.

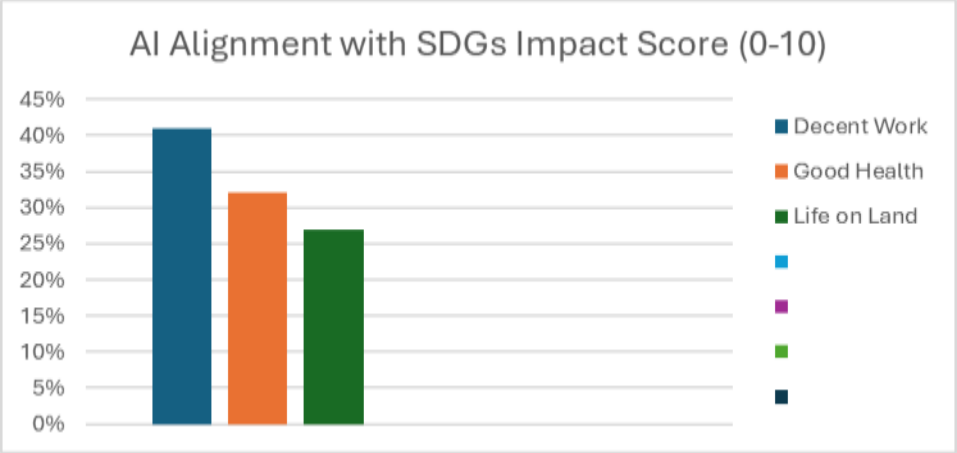

Figure 6. SDG Volume Impact Score Analysis

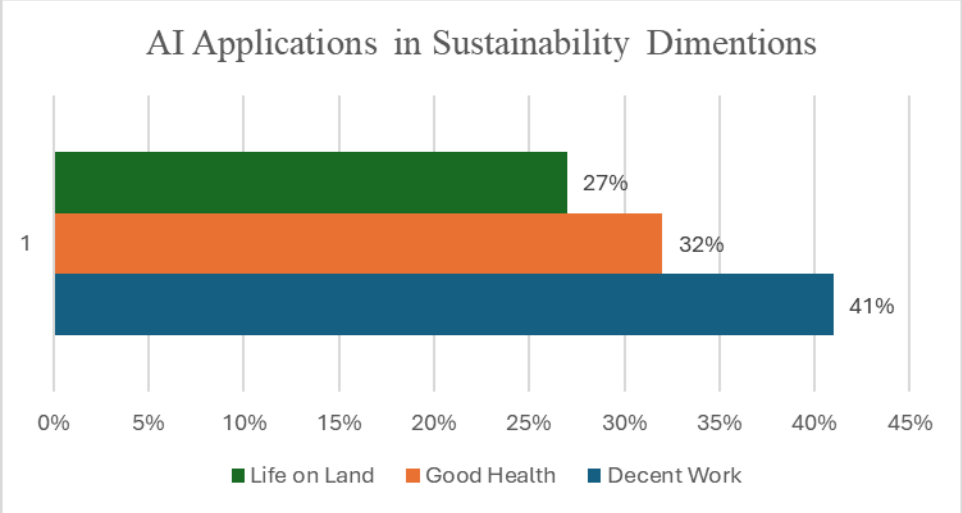

Figure 7. Top Sustainability Dimensions Addressed by AI

DISCUSSION

Sustainable tourism is being transformed with the power of Artificial Intelligence (AI) through better resource management, fewer adverse effects on the environment, and improved visitor experiences as outlined below. It was known that its AI-driven instrumentation, like predictive analytics and machine learning algorithms, played a key role in helping optimize resource management. AI-powered energy management systems were able to lower energy consumption in hospitality facilities by dynamically adjusting lighting, heating, and cooling according to occupancy. Moreover, improve water conservation; AI monitoring solutions & smart irrigation systems promoted resource efficiency without conflating guest satisfaction (Osei et al., 2020; Louati et al., 2024). These innovations showcase how AI can drive operational efficiencies in line with sustainability objectives. For example, AI-powered personalization engines offered access to customized suggestions for eco-conscious lodging and responsible experiences, fostering sustainable practices among tourists. Furthermore, augmented and virtual reality technologies enhanced the cultural and historical narrative and enabled tourists to experience heritage sites sustainably, such that sensitive areas were not overrun by visitors. Such immersive experiences improve visitors' appreciation of cultural heritage while reducing environmental stress (Kim et al., 2024; Li et al., 2022). AI-based tools also helped to reduce carbon footprint by finding optimal energy usage and improving waste management strategies, which proved to be an effective tool of environmental stewardship (Louati et al., 2024). Brand trust and clear CSR communication can greatly affect whether consumers are willing to forgive companies for mistakes related to sustainability. This shows how important it is to be open and engage with stakeholders (Rahman & Chakraborty, 2025).

But there are challenges involved in using AI in sustainable tourism despite these positive results. Some of the key barriers include algorithmic bias, data privacy issues, high implementation costs, and a lack of a common framework to measure sustainability outcomes. These challenges particularly affect small and medium-sized enterprises (SMEs), which struggle with funding and equipment, thus delaying the adoption of AI solutions (Ivanov et al., 2022; Roxas et al., 2020). These challenges must be addressed if AI is to realize its full potential for promoting sustainable tourism.

These findings are consistent with and contribute to previous studies on AI and sustainable tourism. Li (2022) highlighted that AI was being increasingly used for managing the ecological footprints of heritage sites, which strongly supports the current study's emphasis on AI-driven sustainability practices. Similarly, Louati et al. (2024) showed that tourist spending relations and economic resilience are predicted by AI algorithms during disruptions like the COVID-19 pandemic, which echoed the importance of learning from predictive analytics and optimizing available resources in this study. Furthermore, Majid et al. (2023) are in favor of incorporating intelligent automation, which facilitates sustainability, supporting our study findings as well.

But the study also has its limitations that need to be examined further. Implementing AI technologies is a cost-intensive affair, creating significant barriers for small and medium enterprises (SMEs) in particular. There are also ethical issues around data privacy and algorithmic fairness that need further attention to achieve equitable outcomes. Findings also lack generalizability rooted in geospatial and sector-based discrepancies in the adoption of AI-based sustainable practices. Overall, our analysis can support several lines of future research: Developing low-cost AI solutions for SMEs; Establishing methodologies and metrics to quantify environmental, qualitative, and social outcomes; and investigating geography- and industry-based variations in the findings (e.g., green versus non-green industry segments).

Use of Artificial Intelligence in Sustainable Tourism

Artificial Intelligence (AI) stands as a pillar aligning sustainable practices within tourism to tackle the core challenges of ecological preservation, resource management, and economic efficacy. The tourism and hospitality industries, often singled out as spearheading environmentally and socially negative shockwaves, are using AI to reduce their footprints while increasing guest satisfaction. The use of AI tools, including predictive analytics, machine learning, and natural language processing, is crucial in reducing the consumption of resources, increasing operational efficiencies, and enhancing eco-friendly practices among tourists (Majid et al., 2023; Tussyadiah, 2020).
Wondered how the AI technologies are changing the process of resource management in tourism? For example, predictive analytics and machine learning algorithms are used to predict tourist demand, allowing businesses to distribute resources more effectively while reducing waste. AI is used in hotels and resorts with AI-powered energy management systems, which automatically optimize lighting, heating, and cooling depending on occupancy levels, leading to substantial energy savings (Rane et al., 2024; Amissah et al., 2022).

Water conservation is yet another important domain where AI has had success. These features not only make the hotels sustainable but also give the guests a cycle of comfort (Joseph et al., 2019). Smart irrigation systems and AI-driven monitoring solutions are effective and sustainable ways to ensure guest satisfaction without overconsumption of water. AI-powered personalization engines are reshaping visitor experiences by studying user preferences and behaviors. Such systems offer personalized suggestions, directing visitors toward environmentally friendly lodging, responsible tour activities, and sustainable transport options (Kim et al., 2018; Majid et al., 2023). In addition, AI chatbots and virtual assistants contribute to the satisfaction of visitors through real-time support and encourage environmentally friendly travel decisions (Louati et al., 2024). Emerging technologies such as augmented (AR) and virtual reality (VR) were also supporting the strengthening of destination narratives of cultural and natural heritage places, potentially encouraging greater spending and facilitating the alleviation of environmental pressure (Li et al., 2022). Like vortex spinning technology

in textiles, which improved efficiency, reduced costs, and raised product quality, using AI in hospitality can also optimize resources and support sustainable practices (Begum et al., 2018).

AI helps in mitigating the adverse impact of tourism on the environment. AI-based waste management systems, for instance, that track and optimize waste disposal can substantially decrease the likelihood of pollution and improve resource recovery (Zhang et al., 2021). For example, in biodiversity conservation, AI-driven drones and remote sensors help monitor environmental changes and alert against illegal activities, thus contributing to the preservation of vulnerable ecosystems (Liang et al., 2020). Furthermore, in the realm of transportation planning, AI applications have optimized routes, helped minimize fuel consumption, and reduced carbon emissions to make tourism practices more accountable to global sustainability goals (Rane et al., 2023). AI thus opens new ways for the tourism sector to develop sustainably by tackling sustainability challenges (Majid et al., 2023; Rasel & Siddiqi, 2024).

As much as AI could potentially revolutionize sustainable tourism, its adoption within the sector has been stifled by obstacles such as high implementation costs, algorithmic biases, and data privacy issues (Ivanov & Webster, 2019; Roxas et al., 2020). Such barriers are especially prominent in small and medium enterprises (SMEs), where limited financial resources and technical know-how hinder the implementation of state-of-the-art AI systems (Meyer et al., 2024). Creating a path for these challenges to be solved with subsidies, training programs, and standardized frameworks can lead to wider AI adoption throughout the industry (UNEP & UNWTO, 2015). AI for sustainable tourism falls perfectly in line with the aims of this study, as it adopts an exploratory approach to understand the use, challenges, and impacts of AI solutions in tourism and hospitality industries. This study aspires to add to the growing body of knowledge on sustainable tourism by investigating solutions to the environmental challenges posed by seaside parks and creating impactful recommendations through its findings, by examining aspects such as energy efficiency, resource management, and visitor engagement.

The results will identify how AI can act as an enabling force for the balance of economic development, environmental preservation, and social equity that underpins the SDGs and sustainable growth. This work highlights the potential of AI as a tool for developing new solutions to achieve the critical objectives of sustainable tourism. Filling the gap between theory and practice seeks to enable industry players to put into practice AI-powered solutions that will increase operational efficiency, lessen the environmental impact of tourism, and produce more rewarding visits. Ultimately, it tees up a post-pandemic future in which tourism acts as a force for good, parachuting the world into a sustainable, equitable global society.

Optimization of Resource Management

In the context of the hospitality and tourism industry, resource management is an essential element of sustainability, and Artificial Intelligence (AI) has demonstrated its disruptive role in enabling more efficient utilization of resources. By analyzing data to enable accurate IoT insights, machine learning can provide more accurate management plans, ultimately leading to less waste and more profitable operations in all areas of business. AI algorithms are well-suited to this task as they can analyze historical data to detect trends and even forecast demand fluctuations, so that businesses can optimize inventory levels and avoid underutilizing or overstocking resources (Ivanov & Webster, 2019). This minimizes waste, especially in areas such as food and beverage management, which tend to be inefficient by nature.

The predictive analytics aspect of AI takes resource optimization a step further by enabling businesses to forecast guest preferences and manage them accordingly. This mitigates the chances of over-preparation, particularly in the eye of the storm, where luxury establishments often have excessive provisions (Buhalis & Leung, 2018). AI-based energy management systems can monitor energy consumption and automatically change settings to reduce energy consumption without sacrificing guest comfort (Morabito, 2024). Such systems play an important role in saving money while minimizing the environmental impact of operations. AI has also found wide application in water management. Data-driven technologies powered by AI track usage trends and recognize leaks or inefficiencies, allowing for preventative measures. Gössling et al. (2018), these systems can drastically minimize water wastage, which is an important factor in water-stressed areas. Moreover, AI's capability to enhance heating, ventilation, and air conditioning (HVAC) systems ensures that energy usage corresponds to occupancy rates, minimizing operational inefficiencies even more (Gretzel et al., 2020).

AI also helps to implement the principles of the circular economy by enabling waste management and recycling initiatives. Take smart bins with AI that be able to sort waste more efficiently to improve and increase recycling rates and avoid more waste to landfill (Gössling et al.,2019) AI can be combined with IoT (Internet of Things) technologies to provide organizations with a holistic view of their resource usage and help them minimize waste throughout the organization (Ulrich et al., 2022). In addition, AI leads to improved resource management (for example, by optimizing supply chains). Using AI-based platforms, businesses can analyze their suppliers' real-time performance, predict their raw material/stock requirements, and identify the most economical and sustainable procurement channels (Buhalis & Sinarta, 2019). These tools are responsible for ensuring that the supply chain runs smoothly, helping to achieve the larger objectives of resource sustainability and cost-cutting.

Although there are clear advantages to using AI in resource management, there are still challenges to overcome, such as the high initial investment required and the

technical knowledge needed to implement these systems. Despite these initial challenges, the long-term advantages, such as cost savings, improved operational efficiency, and lower environmental impact, make AI a powerful and essential mechanism for achieving sustainable resource administration within the hospitality business (Rasheed et al., 2023). Task automation and streamlined operations are just some of the capabilities of AI in many industries, making it one of the most lucrative areas across sectors. With the use of AI technologies, companies can save substantially and additionally assist in achieving global sustainability goals such as "Responsible Consumption and Production" (SDG 12) as well as "Climate Action" (SDG 13) (UNWTO, 2015). The fact that they have put these advancements into practice emphasizes the evergreen nature of AI in the day-to-day application of sustainable practice in the tourism and hospitality industry and business.

Energy Efficiency and Carbon Footprint Reduction

The sustainable transformation of the tourism and hospitality sectors lies at the intersection of energy efficiency and carbon footprint reductions, where Artificial Intelligence (AI) has emerged as an enabling technology. AI-driven energy management systems are being used more frequently to monitor and optimize energy consumption in real time, allowing businesses to reduce waste and lessen their impact on the environment. Machine learning can analyze usage patterns for energy consumption and program heating, ventilation, and air conditioning (HVAC) to vary with occupancy and weather, allowing for significant energy savings (Gössling et al., 2020; Morabito et al., 2024).

A key application is in the use of AI combined with smart grid technologies that enable the hospitality sector to make use of renewable sources of energy more efficiently. For example, utilizing artificial intelligence (AI) systems to forecast energy demand, monitor energy storage availability, and optimize utilization of renewable energy sources like solar or wind can allow for a reduction in fossil fuel consumption (Buhalis & Leung, 2018). AI can also be harnessed to identify energy inefficiencies and respond with recommendations, upgrading equipment or switching to alternative energy sources (Gretzel et al., 2020).

Another notable application of AI in this space is in predictive maintenance, which allows systems to detect faults in electrical systems and appliances and address them before they result in energy wastage. AI is helping ensure energy-intensive equipment operates at peak efficiency by predicting failures and optimizing the timing of repairs, thereby avoiding unnecessary energy loss and prolonging the lifecycle of the equipment (Hjalager, 2022). Not only does this help reduce negative impact on the environment, but it can also lead to substantial savings for hospitality companies (Ivanov & Webster, 2019). Another important case where AI shows promise is the reduction of our carbon footprint. AI-powered analytics tools can compute carbon emissions for different business operations and offer suggestions to reduce them. AI systems can identify

opportunities for alterations in procurement processes by suggesting local procurement to avoid emissions related to long-distance transportation (Gössling et al., 2020). AI can also monitor carbon emissions, thus helping companies comply with sustainability certifications and standards such as ISO 14001 or the criteria of the Global Sustainable Tourism Council (UNEP, 2016).

While AI has enormous potential to help reduce energy consumption and carbon footprint, its adoption is not without challenges. Challenges such as high implementation costs, limited technical expertise, and data privacy continue to be roadblocks that hold many firms back, particularly small- and medium-sized enterprises (SMEs) (Rasheed et al., 2023). Yet, government incentives as well as partnerships with technology providers are helping to overcome these challenges, allowing for greater adoption of AI-powered solutions in the hospitality industry. Utilizing AI, advanced algorithms, and predictive analytics, companies in this industry can optimize their resource usage, manage real-time demand, and leverage smart grid integrations that will reduce operational costs while aligning with the worldwide sustainability objectives like Affordable and Clean Energy (SDG 7) and Climate Action (SDG 13) (UNWTO, 2015).

Alignment with Sustainable Development Goals (SDGs)

Identification of AI applications that are in line with the Sustainable Development Goals (SDGs) reflects AI's potential contribution to global sustainability targets, especially in the tourism and hospitality industry. The 17 SDGs were set forth by the United Nations in the 2030 Agenda for Sustainable Development. Provide a universal framework for tackling environmental, economic, and social challenges. The application of AI technologies can yield pragmatic contributions towards achieving several of these goals through optimization of resource use, minimizing environmental impacts, and promoting inclusive and sustainable growth (UNWTO, 2015; UNEP, 2016). AI is now one of the most important enablers of SDG 7 (Affordable and Clean Energy). AI-based energy management systems track and optimize energy usage to ensure that operations are energy-efficient while integrating renewable energy sources, such as solar or wind power (Gössling et al., 2020). These systems also provide a path for smart grid integration that allows businesses to limit their dependency on fossil fuels and become energy sustainable for the long term (Morabito et al., 2024).

AI's implications reach far with SDG 12 (Responsible Consumption and Production) as well. Predictive analytics and resource optimization tools help minimize waste by ensuring that only required resources are used, particularly useful in food and beverage management, as well as inventory management. AI-based demand forecasting helps reduce overproduction (Ivanov & Webster, 2019), while Gretzel et al. (2020) demonstrate that AI can be used to promote circular economy initiatives, including waste reduction and recycling. In the realm of SDG 13 (Climate Action), the AI applications assist in reducing the carbon footprint of tourism and hospitality operations. AI-assisted carbon footprinting applications measure the carbon footprint of goods or

services and recommend actions that can help mitigate these contributions, including transportation logistics and energy conservation, among others (Gossling et al., 2021). Artificial Intelligence also helps climate action by processing big data to assess the environmental consequences of tourism endeavors, allowing policymakers to create measures that harmonize economic development and ecological conservation (Hjalager, 2022). Providing decent work and economic growth, another of the Sustainable Development Goals (SDGs), is also influenced by AI, as it promotes creativity and opens new avenues for sustainable economic development. AI not only generates employment opportunities in these fields by freeing businesses from operational tasks but also creates value by enhancing productivity (Buhalis & Leung, 2018). Moreover, AI-based tools support workforce training, which helps skill development for the employees in the new era of technology to contribute towards sustainable practices (Rasheed et al, 2024). Additionally, AI assists in meeting SDG 15 (Life on Land) goals through its application to conservation efforts. Examples include AI applications in destination management that track visitor flows, where they help to reduce the detrimental impacts of overtourism on biodiversity and ecosystems (Gössling & Hall, 2018). These tools help safeguard natural and cultural heritage sites for future generations.

Predictive Analytics for Sustainable Tourism Planning

The use of predictive analytics, driven by AI, is transforming sustainable tourism planning towards a data audience-driven approach to tackling environmental, economic, and social issues. Using sophisticated algorithms, machine learning models, and big data analytics, predictive analytics allows stakeholders to (1) foresee future developments, (2) optimize resource use, and (3) craft strategies that reconcile the conflicting objectives of tourism growth and environmental conservation (Gössling & Hall, 2018; Morabito, 2024). Predictive analytics has seen its ability demonstrated with one of its more impactful implementations, managing tourist flows to combat the issue of overtourism that is becoming increasingly prevalent in popular destinations. For example, analyzing historical tourism trends, weather data, and real-time observations from visitors, AI systems can identify expected peak times and busy areas, enabling policymakers to introduce measures such as capacity restrictions or alternative routes and encourage more even tourist dispersal (UNWTO, 2015). This helps protect natural and cultural heritage sites and improve the propagative experience for visitors (Gretzel et al., 2020).

Utilization of predictive analytics also facilitates sustainable resource allocation by estimating demand for services like accommodation, transportation, and utilities. AI applications can also be used in predicting the occupancy rates in hotels, allowing businesses to adjust their staff, energy, and inventory at the right levels (Ivanov & Webster, 2019). In this way, waste is reduced, and the environmental footprint of tourism operations is minimized, contributing to Sustainable Development Goals (SDGs) such as Responsible Consumption and Production (SDG 12) (Table 1) and Affordable and Clean Energy (SDG 7) (Table 1). Machine learning in Climate Actions: Contact analysis and Prediction of Environmental Impact of Tourism. AI analytics can model scenarios based

on the adoption of alternative policies or advancement programs, such as carbon offset initiatives or transitioning to renewable energy sources. By using these simulations, stakeholders can assess the long-run sustainability of tourism projects as well as adopt actions that will appl y to Climate Action (SDG 13) (Table 1) (Gössling et al., 2020).

Moreover, predictive analytics allow destination management to unlock new possibilities in such travel trends and preferences. Through the study of online search behaviors, social media discussions, and booking trends, AI tools assist destinations in creating customized marketing initiatives, including sustainable tourism products that cater to demand and promote alternative and less frequented destinations (Hjalager, 2022). This not only diversifies tourist flows but also benefits local economies and alleviates pressure in overwhelmed hotspots. AI's ability to predict and mitigate risks is yet another way in which it can contribute to sustainability planning in tourism. Destinations can use predictive models to predict natural disasters like floods or hurricanes, so that they can prepare and protect tourists and even local communities. In other health crisis scenarios like the COVID-19 pandemic, AI has played a role in monitoring infection rate responses and adaptability of tourism stakeholders' operations to ensure safety (Buhalis & Sinarta, 2019). Although predictive analytics is highly useful, it is not without difficulties in the implementation process. Predictions can only be as good as the data used to derive them, and there are gaps in data availability, quality, and granularity that are region, organization, and sector dependent. She further argued that smaller destinations and businesses do not have the technical capabilities or resources to support predictive analytics, indicating a need for capacity development and knowledge transfer (Rasheed et al., 2023). Additionally, ethical issues surrounding both data privacy and algorithmic transparency should also be considered for the ethical use of predictive technologies (Morabito, 2024).

Enhancing Customer Experiences Sustainably

Artificial Intelligence (AI) is transforming the hospitality and tourism industry to improve customer experience, while also encouraging sustainability. With personalized and high-quality services, reduced resource use, and environmental impact. Such dual emphasis on customer satisfaction as well as sustainable practices is essential for the long-term success in the industry (Buhalis et al., 2018; Gretzel et al., 2020). One of the most significant applications of AI to create sustainable customer experiences lies in personalization for recommendations and services. AI algorithms analyze customer preferences, past booking histories, and behavior patterns to pull personalized recommendations across accommodations. This addresses excessive provision of redundant services and adjusts supply to demand, which decreases waste (Ivanov & Webster, 2019). For example, AI-generated personalized itineraries can encourage visitors to travel during off-peak seasons and venture to less touristy locales, helping to relieve pressure on overcrowded tourist hotspots while stimulating local economies (Gössling et al., 2020).

One of these includes AI-based chatbots and virtual assistants, which help in enhancing customer support and also in saving a few resources. These tools manage routine queries, like changes to reservations and questions about destinations, delegating staff to more complex tasks. AI offers immediate support at any time of day, which minimizes the need for heavy staffing, thus saving both resources and operational costs (Buhalis and Sinarta 2019). Furthermore, AI chatbots frequently suggest environmentally friendly alternatives, like green-certified hotels or low-impact actions, increasing the awareness of sustainability options to the travelers (Gretzel et al., 2020). AI-enabled smart room technologies are utilized throughout the hotel, reducing energy and water usage while optimizing guest comfort, and ultimately contributing to sustainability. Smart thermostats, lighting systems, and water-saving technologies, for instance, adjust automatically depending on occupancy, allowing resources to be used efficiently while not hindering the guests' experience (Morabito, 2024). Not only do these systems improve customer satisfaction by ensuring a smooth experience during their stay, but they are also responsible for a tremendous energy-saving effect, contributing to Sustainable Development Goals (SDG 7: Affordable and Clean Energy) (Table 1).

CONCLUSIONS

The study reiterates the significant role of Artificial Intelligence (AI) in sustainable tourism, particularly in optimizing resources and increasing efficiency in hospitality. The research highlights how AI can revolutionize the tourism sector by tackling one of the double challenges, such as environmental degradation and socio-economic equity, both of which are illustrated within the Sustainable Development Goals (SDGs). What has emerged aligns with the view that AI applications focus on energy efficiency and resource optimization within architectural practices, thus aiming at minimizing their environmental impact, as well as optimizing labor and improving the experience of visitors through enhanced building use. Amongst these, SDG 7 (Affordable and Clean Energy), SDG 12 (Responsible Consumption and Production), and SDG 13 (Climate Action) had particularly significant synergies. The main practical import of this research is that AI-enabled solutions like predictive analytics, energy management systems, and smart technologies can lead to reduced wastage of resources, optimized operating efficiencies, and environmentally responsible behaviors.

In addition, the adoption of AI-powered solutions in sustainable practices also enables the uranium sector to develop a more resilient and equitable ecosystem, empowering it to succeed against future challenges on a global scale. But to ensure that AI at scale is equitable across all scales of the industry, we must address barriers like high implementation costs, algorithmic bias, and data privacy concerns. This study adds to the literature by illustrating how AI can enhance sustainable tourism practices in the hospitality industry, ultimately offering practical measures for those working in the hospitality sector. It lays the groundwork for exploring the design of sustainable, affordable, and scalable AI capabilities that will underpin the review of sustainability in AI,

consequently guiding the way for future developments while helping to maintain sustainability goals at the heart of the industry's development trajectory.

RECOMMENDATIONS

This study recommends expanding the use of scalable and affordable AI technologies in the hospitality industry to enhance sustainability efforts. Government bodies and tourism organizations should offer financial and technical support to small and medium-sized enterprises (SMEs) to facilitate AI adoption. Establishing standardized sustainability assessment frameworks aligned with the Sustainable Development Goals (SDGs) is essential. Ethical concerns such as data privacy and algorithmic fairness must also be addressed to ensure responsible and equitable AI implementation.

IMPLICATIONS

The findings of this study provide practical and academic value. For practitioners, the integration of AI tools such as predictive analytics and smart energy systems can lead to more efficient operations and reduced environmental impacts in hospitality. For researchers, this study contributes to the growing literature on sustainable tourism by highlighting AI's alignment with global sustainability goals. It also sets a foundation for future research on the long-term effects and regional variations of AI adoption in tourism and hospitality contexts.

DECLARATIONS

Conflict of Interest

I declare that there is no conflict of interest in this study.

Informed Consent

All co-authors confirm that consent was obtained from all participants.

Ethics Approval

Ethical approval for this study was obtained from the institution's ethics committee.

REFERENCES

Amissah, E. F., Blankson-Stiles-Ocran, S., & Mensah, I. (2022). Emotional labor, emotional exhaustion, and job satisfaction in the hospitality industry. *Journal of Hospitality and Tourism Insights*, 5(5), 805-821. https://doi.org/10.1108/JHTI-10-2020-0196

Begum, H. A., Khan, M. K. R., & Rahman, M. M. (2018). An overview on spinning mechanism, yarn structure, and advantageous characteristics of vortex spun yarn and fabric. *Advances in Applied Sciences,* 3(5), 58–64. https://doi.org/10.11648/j.aas.20180305.11

Buhalis, D., & Leung, R. (2018). Smart hospitality—Interconnectivity and interoperability towards an ecosystem. *International Journal of Hospitality Management*, 71, 41-50. https://doi.org/10.1016/j.ijhm.2017.11.011

Buhalis, D., & Sinarta, Y. (2019). Real-time co-creation and nowness service: lessons from tourism and hospitality. *Journal of Travel & Tourism Marketing*, 36(5), 563-582. https://doi.org/10.1080/10548408.2019.1592059

Buhalis, D., & Sinarta, Y. (2019). Real-time co-creation and nowness service: lessons from tourism and hospitality. *Journal of Travel & Tourism Marketing*, 36(5), 563-582. https://doi.org/10.1080/10548408.2019.1592059

Gössling, S., & Hall, C. M. (2019). Sharing versus collaborative economy: How to align ICT developments and the SDGs in tourism? *Journal of Sustainable Tourism,* 27(1), 74–96. https://doi.org/10.1080/09669582.2018.1560455

Gössling, S., & Peeters, P. (2015). Assessing tourism's global environmental impact 1900–2050. *Journal of Sustainable Tourism,* 23(5), 639–659. https://doi.org/10.1080/09669582.2015.1008500

Gössling, S., Scott, D., & Hall, C. M. (2020). Pandemics, tourism, and global change: A rapid assessment of COVID-19. *Journal of Sustainable Tourism,* 29(1), 1–20. https://doi.org/10.1080/09669582.2020.1758708

Gössling, S., & Hall, C. M. (2018). A literature review of AI in tourism: Impacts on sustainability and education. *Journal of Sustainable Tourism,* 26, 1–20.

Gretzel, U., Fesenmaier, D., & O'Leary, J. (2020). Impact of predictive analytics on tourism management: A comprehensive review. *Journal of Travel Research,* 59, 873–887.

Hansen, D., Shneiderman, B., & Smith, M. A. (2010). *Analyzing social media networks with NodeXL: Insights from a connected world.* Morgan Kaufmann.

Hjalager, A. M. (2022). Digital food and the innovation of gastronomic tourism. *Gastronomy and Tourism,* 7(1), 35–49. https://doi.org/10.3727/216929722X16354101932186

Ivanov, S., & Webster, C. (2019). *Robots, artificial intelligence, and service automation in travel, tourism, and hospitality* (1st ed.). Emerald Publishing Limited. https://doi.org/10.1108/978-1-78756-687-320191014

Ivanov, S., Webster, C., Stoilova, E., & Slobodskoy, D. (2022). Biosecurity, crisis management, automation technologies, and economic performance of travel, tourism, and hospitality companies – A conceptual framework. *Tourism Economics,* 28(1), 3–26. https://doi.org/10.1177/1354816620946541.

Joseph, S. C., Joseph, A., Jayan, P. P., & Dhanesh, P. R. (2019, October). Energy Efficient House Boats for Sustainable Backwater Tourism. In *2019 Global Conference for Advancement in Technology (GCAT)* (pp. 1-5). IEEE. https://doi.org:10.1109/GCAT47503.2019.8978415.

Kim, H., So, K. K. F., Shin, S., & Li, J. (2024). Artificial intelligence in hospitality and tourism: Insights from industry practices, research literature, and expert opinions. *Journal of Hospitality & Tourism Research*, 10963480241229235. https://doi.org/10.1177/10963480241229235

Kim, M. S., Kim, J., & Thapa, B. (2018). Influence of environmental knowledge on affect, nature affiliation, and pro-environmental behaviors among tourists. Sustainability, 10(9), 3109. https://doi.org/10.3390/su10093109

Koo, C., Xiang, Z., Gretzel, U., & Sigala, M. (2021). Artificial intelligence (AI) and robotics in travel, hospitality, and leisure. *Electronic Markets*, *31*, 473-476. https://doi.org/10.1007/s12525-021-00494-z.

Li, W. (2022). *Prediction of tourism demand in Liuzhou region based on machine learning. Mobile Information Systems, 2022,* 1–9. https://doi.org/10.1155/2022/9362562

Li, X., Wang, Y., & Zhang, H. (2022). *The role of machine learning in enhancing the precision of tourism forecasting. Annals of Tourism Research, 89,* 103145. https://doi.org/10.1016/j.annals.2021.103145

Liang, W., Fan, Y., Li, K.-C., Zhang, D., & Gaudiot, J.-L. (2020). *Secure data storage and recovery in industrial blockchain network environments. IEEE Transactions on Industrial Informatics,* 16(10), 6543–6552. https://doi.org/10.1109/GCAT47503.2019.8978415

Liu, Z. (2003). *Sustainable tourism development: A critique. Journal of Sustainable Tourism, 11*(6), 459–475. https://doi.org/10.1080/09669580308667216

Louati, A. (2023). *Cloud-assisted collaborative estimation for next-generation automobile sensing. Engineering Applications of Artificial Intelligence, 126,* 106883. https://doi.org/10.1016/j.engappai.2023.106883

Louati, A., Louati, H., Kariri, E., Neifar, W., Farahat, M. A., El-Hoseny, H. M., Hassan, M. K., & Khairi, M. H. (2024). *Sustainable urban mobility for road information discovery-based cloud collaboration and Gaussian processes. Sustainability, 16,* 1688. https://doi.org/10.3390/su16041688

Louati, H., Louati, A., Lahyani, R., Kariri, E., & Albanyan, A. (2024). *Advancing sustainable COVID-19 diagnosis: Integrating artificial intelligence with bioinformatics in chest X-ray analysis. Information, 15*(4), 189. https://doi.org/10.3390/info15040189

Majid, G. M., Tussyadiah, I., Kim, Y. R., & Pal, A. (2023). *Intelligent automation for sustainable tourism: A systematic review. Journal of Sustainable Tourism, 31*(11), 2421–2440. https://doi.org/10.1080/09669582.2023.2246681

Majid, M., Habib, S., Javed, A. R., Rizwan, M., Srivastava, G., Gadekallu, T. R., & Lin, J. C. W. (2022). *Applications of wireless sensor networks and Internet of Things frameworks in the Industry Revolution 4.0: A systematic literature review. Sensors, 22*(6), 2087. https://doi.org/10.3390/s22062087

Md Merajur Rahman, & Chakraborty, S. (2025). "I know the brand is better than that": Brand trust and consumer-brand identification evoking brand forgiveness after

CSR-related wrongdoings. *Social Responsibility Journal, 21*(7), 1401–1420. https://doi.org/10.1108/SRJ-01-2025-0072

Meyer, L. M., Stead, S., Salge, T. O., & Antons, D. (2024). *Artificial intelligence in acute care: A systematic review, conceptual synthesis, and research agenda. Technological Forecasting and Social Change, 206,* 123568. https://doi.org/10.1016/j.techfore.2024.123568

Morabito, R., & Chiang, M. (2024). *Exploring Edge AI inference in heterogeneous environments: Requirements, challenges, and solutions.* In *IoT Edge Intelligence* (pp. 37–66). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-58388-9_2

Osei, B. A., Ragavan, N. A., Kandappan, B., & Mensah, H. K. (2020). Hospitality revolution 4.0: A literature review on a unified typology of IR 4.0 technologies for the tourism and hospitality industry in the era of COVID-19. Asia-Pacific Journal of Innovation in Hospitality and Tourism (APJIHT), 9(1), 25-45. Retrieved from https://fslmjournals.taylors.edu.my/wp-content/uploads/APJIHT/APJIHT-2020-9-1/APJIHT-2020-P2-9-1.pdf

Rane, N. (2023). *Integrating leading-edge artificial intelligence (AI), Internet of Things (IoT), and big data technologies for smart and sustainable architecture, engineering, and construction (AEC) industry: Challenges and future directions.* SSRN. https://doi.org/10.2139/ssrn.4616049

Rane, N., Choudhary, S., & Rane, J. (2024). *Artificial intelligence for enhancing resilience. Journal of Applied Artificial Intelligence, 5*(2), 1–33. https://doi.org/10.48185/jaai.v5i2.1053

Rasel, M. A. B. (2024). *Navigating sustainability in the tourism and hospitality industry: Transformation under the influence of climatic challenges. SocioEconomic Challenges, 8*(4), 112–120. https://doi.org/10.61093/sec.8(4).112-120.2024

Rasel, M. A. B., & Siddiqi, M. T. H. (2024). *Navigating sustainability in the tourism and hospitality industry: An exploratory study of sustainable practices, antecedents, and effects. Journal of Tourism and Hospitality Studies, 2*(2), 19–25. https://doi.org/10.32996/jths.2024.2.2.2

Rasheed, H. M. W., He, Y., Khizar, H. M. U., & Abbas, H. S. M. (2023). *Exploring consumer–robot interaction in the hospitality sector: Unpacking the reasons for adoption (or resistance) to artificial intelligence. Technological Forecasting and Social Change, 192,* 122555. https://doi.org/10.1016/j.techfore.2023.122555

Roxas, F., Rivera, J., & Gutierrez, E. (2020). *Framework for creating sustainable tourism using systems thinking. Current Issues in Tourism, 23*(3), 280–296. https://doi.org/10.1080/13683500.2018.1534805

Santos, V., Sousa, M., Costa, C., & Au-Yong-Oliveira, M. (2021). *Tourism towards sustainability and innovation: A systematic literature review. Sustainability, 13*(20), 11440. https://doi.org/10.3390/su132011440

Tussyadiah, I. (2020). *A review of research into automation in tourism: Launching the Annals of Tourism Research Curated Collection on Artificial Intelligence and Robotics in Tourism. Annals of Tourism Research, 81,* 102883. https://doi.org/10.1016/j.annals.2020.102883

Ulrich, A. M. D., Reino, K., & Hjalager, A. M. (2022). Innovative internet of things (IoT) for sustainable tourism. In *Handbook of innovation for sustainable tourism* (pp. 61–81). Edward Elgar Publishing. https://doi.org/10.4337/9781800372740.00013

United Nations Environment Programme (UNEP), & World Tourism Organization (UNWTO). (2005). *Making tourism more sustainable.* United Nations Environment Programme and World Tourism Organization. https://doi.org/10.18111/9789284408214

United Nations Environment Programme. (2017). *UN Environment 2016 annual report.* https://wedocs.unep.org/bitstream/handle/20.500.11822/19529/UN%20Environment%202016%20Annual%20Report.pdf?sequence=1&isAllowed=y

World Tourism Organization (UNWTO). (2018, March 6). *Tourism can and should lead sustainable development: UNWTO Secretary-General opens ITB 2018* (Press release No. PR 18020). https://www.unwto.org/tourism-can-and-should-lead-sustainable-development-unwto-secretary-general-opens-itb-2018

UNWTO. (2020). *Statistical annex 2023, World tourism barometer* (Vol. 21). World Tourism Organization (UNWTO). https://www.unwto.org/unwto-world-tourism-barometer-and-statistical-annex-december-2020

World Tourism Organization, & United Nations Development Programme. (2017). *Tourism and the sustainable development goals – Journey to 2030.* UNWTO. https://doi.org/10.18111/9789284419401

Xu, Y., Liu, X., Cao, X., Huang, C., Liu, E., Qian, S., ... & Zhang, J. (2021). Artificial intelligence: A powerful paradigm for scientific research. *The Innovation*, *2*(4). https://doi.org/10.1016/j.xinn.2021.100179

Zhang, Y., Li, G., Muskat, b., & Law, R. (2021). Tourism demand forecasting: A decomposed deep learning approach. *Journal of Travel Research, 60*(5), 981–997. https://doi.org/10.1177/0047287520919522.

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