OPTIMIZING BEACH TOURISM THROUGH SMART SOLUTIONS: A COMPREHENSIVE REVIEW OF SMART TECHNOLOGIES AND SUSTAINABLE STRATEGIES

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Abstract

The growth of beach tourism has introduced both opportunities and challenges for destination management, necessitating innovative approaches to sustain and enhance beach environments. This paper reviews the literature on smart beach management and sustainable practices, focusing on how real-time data and smart technologies can address common issues such as overcrowding, environmental degradation, and resource inefficiency. By examining the 6 A's Framework—Attractions, Accessibilities, Amenities, Activities, Available Packages, and Ancillary Services—this study highlights the importance of a holistic approach to managing beach tourism. The review underscores the potential of smart technologies to improve visitor experiences, enhance safety, and optimize resource use. However, it also identifies significant research gaps, including the limited empirical evidence on the effectiveness of smart beach strategies and the need for integrated management models. Future research should aim to develop comprehensive smart beach management frameworks and empirically assess the impact of these technologies on tourist satisfaction and environmental outcomes. The findings emphasize the importance of adopting sustainable and smart practices to ensure the long-term viability of beach tourism and enhance the quality of tourist experiences. This paper contributes to the discourse on smart tourism by providing a critical overview of current literature and suggesting directions for future research to support the development of effective beach management policies.

Key words: *Smart Beach Management, Sustainable Tourism, Real-Time Data, Beach Tourism Framework, Smart Beaches.*

JEL Classification: *O1, P2, Z3*

I. INTRODUCTION

Beach tourism is a critical segment of the global tourism industry, significantly contributing to the economies of coastal destinations worldwide. With increasing tourist numbers and a growing emphasis on sustainable tourism practices, there is a need for smarter and more efficient beach management. The concept of "smart beaches" has emerged as a response to this demand, where real-time information dissemination and technology integration are leveraged to enhance the beach tourism experience (Buhalis & Amaranggana, 2013; Sigalat-Signes et al., 2020)). This approach aligns with the broader framework of Smart Tourism Destinations (STDs), which integrates Information and Communication Technologies (ICTs) to optimize resources, improve management efficiency, and provide meaningful experiences to tourists (Paraschi, (2023). Within this context, Goa, India—a prominent beach tourism destination—is an ideal case for exploring the implementation of smart beach strategies.

The framework for understanding smart tourism destinations can be effectively built around Buhalis and Amaranggana's (2013) 6A's Framework. This framework outlines six key components essential for the development of competitive and sustainable tourism destinations: Attractions, Accessibility, Amenities, Activities, Available Packages, and Ancillary Services. Each of these components plays a crucial role in shaping the overall tourist experience and destination appeal, especially in the context of beach tourism. For instance, amenities have traditionally been undervalued in beach management, with a historical focus on coastal defense rather than on enhancing recreational and aesthetic experiences (Kindeberg et al., 2023). Recent studies, however, have emphasized that amenities are a critical factor in tourists' perception of beaches and play a substantial role in attracting visitors (Boto-García & Leoni, 2023). Consequently, real-time information about amenities is vital for beach management authorities to maintain the attractiveness and safety of these areas (Leatherman et al., 2024).

Safety and security are other critical concerns for beach tourism (Preko, 2021). While safety is a top priority for tourists, there has been a lack of attention to issues such as safe access and secure environments at beaches (Chen & Teng, 2016). The integration of smart technologies, such as crowd management systems and real-time monitoring, can significantly enhance the safety and overall experience of tourists (Alam et al., 2017). Furthermore, the use of big data and Internet of Things (IoT) technologies can support traffic and congestion management, thereby improving accessibility and mobility around beach areas (Girau et al., 2018). Accessibility remains a significant challenge in many beach destinations, particularly concerning traffic jams, parking availability, and inclusive facilities for people with disabilities (Polnyotee & Thadaniti, 2015; Mayordomo-Martínez et al., 2019). By implementing smart parking solutions and real-time traffic information systems, destinations can alleviate these issues and improve accessibility for all tourists (Alam et al., 2017).

The attraction of a beach destination is often determined by a combination of natural and artificial features that offer recreational experiences (Botero et al., 2018). Various studies have highlighted that destination choices are significantly influenced by the spatial distribution of attractions and the availability of favorable weather conditions (Matthews et al., 2018; Rutty & Scott, 2014). Understanding these factors is crucial for destination management to create strategic plans that cater to tourist preferences (Rosselló & Waqas, 2016). Moreover, the availability of comprehensive, real-time data on weather conditions and other attractions can guide tourists in their decision-making process, enhancing their overall experience (Perch-Nielsen, 2010).

Additionally, activities offered at beach destinations, such as swimming, surfing, and outdoor recreation, are fundamental components of the tourism experience (Pascoe, 2019). The provision of smart services can help manage these activities more sustainably, improving the quality of the tourist experience while mitigating potential negative impacts, such as overcrowding (Needham & Szuster, 2011). Similarly, well-designed available packages that combine multiple services, such as guided tours and special interest packages, can enhance tourists' satisfaction and provide a competitive edge to destinations (Arif et al., 2019; Gitonga, 2021). Ancillary services, such as safety facilities, ATMs, and emergency medical services, also play a pivotal role in enhancing the comfort and safety of tourists (Tukamushaba et al., 2016; Devi Valeriani & Putri, 2020).

Despite the growing body of literature on smart beaches and beach tourism, there remain significant research gaps. Most existing studies are fragmented, focusing on individual components like safety, accessibility, or amenities without a holistic approach that integrates these elements. Furthermore, empirical research on the effectiveness of smart technologies in enhancing tourists' experiences and satisfaction is limited. Addressing these gaps is critical to developing more comprehensive and integrated models for smart beach management. Therefore, this literature review aims to synthesize the existing research, identify gaps, and suggest future research directions for developing smart, sustainable beach destinations.

II. LITERATURE REVIEW

Theoretical Framework and Concepts

Smart Tourism Destinations (STDs)

Smart Tourism Destinations (STDs) represent an evolution in tourism management, incorporating information and communication technologies (ICTs) to enhance tourist experiences, optimize resource management, and improve overall destination efficiency (Paraschi, (2023). Buhalis and Amaranggana (2013) introduced the concept of STDs, which are characterized by the integration of technology, stakeholders, and processes that collect, analyze, and leverage data to support decision-making and sustainable tourism development. The goal of an STD is to foster interconnectedness among various stakeholders, including tourists, local communities, businesses, and government entities, to deliver personalized and enhanced experiences while ensuring the sustainable management of resources (Buhalis & Amaranggana, 2013; Errichiello & Micera, 2021).

STDs rely on advanced ICT tools like sensors, big data analytics, cloud computing, and mobile applications to collect real-time information and provide insights that can guide tourists and stakeholders. As destinations become "smart," they can better manage tourism flows, understand tourist preferences, and provide tailored services. This approach improves resource efficiency and supports sustainability by minimizing waste, reducing environmental impacts, and promoting responsible tourism practices (Sigalat-Signes et al., 2020).

Smart Beaches

Smart Beaches represent a specific application of the broader concept of Smart Tourism Destinations. They leverage technology to address issues such as overcrowding, safety, environmental degradation, and user experience. Through the use of sensors, IoT devices, and data analytics, smart beaches provide real-time information about visitor density, weather conditions, water quality, available amenities, and other factors that enhance the overall beach experience (Alam et al., 2017). Smart Beach initiatives also play a crucial role in crowd management, environmental monitoring, and emergency response, making them a key component in sustainable tourism practices (Girau et al., 2018).

The need for smart beaches arises from the increasing popularity and economic significance of beach tourism, which can result in overcrowding,

littering, and environmental degradation. Addressing these challenges requires innovative solutions that integrate technological tools with management strategies, thereby ensuring a balanced approach to enhancing tourist experiences while preserving natural resources (Errichiello & Micera, 2021).

Sustainable Beach Management

Sustainable beach management is critical for maintaining the ecological integrity of beach environments while supporting tourism activities (Rodil at al., 2022). It involves adopting practices that minimize environmental impacts, such as habitat destruction, sand loss, and pollution, while maximizing socio-economic benefits (de Schipper et al., 2021). Sustainable management strategies include regulating visitor numbers, improving waste management, and monitoring beach conditions using advanced technology to ensure that beaches remain attractive and safe for both locals and tourists (Chen & Teng, 2016; Botero et al., 2014).

In sustainable beach management, the emphasis is on understanding and managing the multidimensional nature of beaches, considering their ecological, social, and economic aspects. This includes taking into account tourists' needs, perceptions, and preferences regarding beach quality and ensuring that these elements are preserved or enhanced through appropriate management interventions (Gounden, 2021)

Buhalis and Amaranggana (2013) proposed the 6 A's Framework as a tool for analyzing and managing tourism destinations. The framework identifies six key components that contribute to the success and competitiveness of a destination: Attractions, Accessibilities, Amenities, Activities, Available Packages, and Ancillary Services. Each of these components plays a vital role in shaping tourists' experiences and satisfaction at a destination, particularly in the context of beach tourism.

1. **Attractions**: Attractions refer to the natural and artificial features that draw tourists to a destination. In the context of beach tourism, attractions can include the physical beach environment, scenic beauty, and unique coastal ecosystems, as well as built attractions like beach resorts, promenades, and piers (Botero et al., 2018). The demand for beach tourism is often influenced by factors such as weather conditions, accessibility, and the quality of the beach environment, which makes it essential to manage these attractions effectively to retain their appeal (Rosselló & Waqas, 2016).
2. **Accessibilities**: Accessibility involves the ease with which tourists can reach a destination, including transportation options, infrastructure, and wayfinding systems (Cappola et al., 2022; Qiao et al., 2023). For beaches, this means ensuring adequate parking, public transportation links, and facilities like restrooms. Accessibility challenges, such as traffic congestion and inadequate parking, can significantly affect the beach experience, making it essential to adopt smart solutions like real-time parking information and traffic management systems to enhance accessibility (Alam et al., 2017; Polnyotee & Thadaniti, 2015).
3. **Amenities**: Amenities refer to the facilities and services available to tourists at a destination, such as accommodations, restaurants, and leisure facilities (Siwek et al., 2022). For beaches, amenities also include safety measures like lifeguards, beach cleaning services, and facilities for water sports and other recreational activities (Mensah, 2021). Proper management of amenities is crucial for enhancing tourists' beach experiences, ensuring safety, and maintaining the beach environment's aesthetic and recreational value (Frampton, 2010; Boto-García & Leoni, 2023).
4. **Activities**: Activities are the various recreational options available to tourists at a destination, including swimming, sunbathing, fishing, and other beach-related activities (D'Souza, 2024). The quality and diversity of these activities can significantly influence tourist satisfaction and destination competitiveness. Understanding tourists' preferences for different activities and managing them in a way that minimizes environmental impact and overcrowding is essential for sustainable beach tourism development (Needham & Szuster, 2011; Pascoe, 2019).
5. **Available Packages**: Available packages refer to the combination of services offered to tourists, such as guided tours, adventure packages, and all-inclusive deals (Cozzio et al., 2023). These packages can enhance the tourist experience by providing convenience, value for money, and personalized options that cater to different preferences. Developing effective packages that align with tourists' expectations and needs can help destinations attract and retain visitors (Liao & Chuang, 2020; Amissah et al., 2022).
6. **Ancillary Services**: Ancillary services are the supplementary services that support tourism activities, such as banks, ATMs, healthcare facilities, and emergency services (Marwani et al., 2023). These services are crucial for ensuring tourists' safety, comfort, and convenience, contributing to an overall positive experience at a destination. Effective management of ancillary services, especially in emergencies, can enhance destination

competitiveness and satisfaction (Öztüren et al., 2021; Tukamushaba et al., 2016).

Review of Existing Literature

The following section reviews the existing literature on key constructs related to smart beaches and beach tourism. The review is organized around the main components of the 6 A's Framework and other critical concepts to provide a comprehensive understanding of the subject matter.

Attractions in Beach Tourism

Beach tourism, a cornerstone of the global tourism industry, has evolved significantly over time. While the allure of sun, sand, and sea remains central, modern tourists seek a more diverse and immersive experience. Beach attractions, a significant draw for tourists, are composed of both natural and artificial elements that provide recreational experiences (Botero et al., 2018).

Destination choices are often influenced by the spatial distribution of attractions (Matthews et al., 2018). Pre-planning for tourism development is crucial to maintain destination attractiveness and meet the growing demand for beach recreation (Öztüren et al., 2021). Recreational opportunities such as swimming, fishing, surfing, and simply enjoying the seaside are major draws for beach visitors (Pascoe, 2019).

Weather conditions play a significant role in beach tourism decision-making (Rosselló & Waqas, 2016). Tourists are more likely to choose destinations with favorable weather conditions, particularly for activities like swimming and sunbathing (Rutty & Scott, 2014; Perch-Nielsen, 2010). Understanding the relationship between weather and tourism demand is essential for tourism organizations to provide accurate information to potential visitors (Rutty & Scott, 2014).

The impact of climate change on beach tourism cannot be ignored. Hansen et al. (2010) emphasize the need for climate-smart conservation strategies to maintain the resilience of beach ecosystems. Beach tourism activities are highly sensitive to weather conditions, and climate change can pose significant challenges to their sustainability (Perch-Nielsen, 2010).

Beach attractions are therefore a key factor in attracting tourists. Their management is crucial for maintaining destination appeal, especially in the face of climate change. By understanding the relationship between weather conditions, visitor preferences, and the spatial distribution of attractions, tourism organizations can develop effective strategies to promote and sustain beach tourism.

Accessibility and Beach Tourism

Beach tourism, while immensely popular, often faces significant challenges related to accessibility. Traffic congestion, limited parking availability, and the absence of proper traffic management infrastructure pose significant hurdles for visitors. Moreover, the encroachment of commercial activities on public spaces, such as parking areas and restrooms, can further exacerbate these problems (Polnyotee & Thadaniti, 2015).

To address these issues, the implementation of smart technologies is crucial. Real-time parking information systems can significantly reduce the time spent by tourists searching for parking, alleviating traffic congestion (Alam et al., 2017). Traffic monitoring systems can help optimize traffic flow, improving accessibility to beaches (Girau et al., 2018). Additionally, webcam monitoring can provide valuable insights into beach visitor density and behavior, aiding in effective crowd management (Donaire et al., 2020).

The integration of smart technologies can also enhance safety and traffic management. Co-operative sensing in the Internet of Things (IoT) can enable real-time dissemination of information such as wrong way warnings, traffic jam alerts, accident notifications, road work updates, and alternative routes (Alam et al., 2017). This can significantly improve traffic flow and reduce congestion, particularly during peak tourist seasons.

Moreover, accessibility must extend to all visitors, including those with disabilities. Mayordomo-Martínez et al. (2019) emphasize the importance of inclusive tourism resources to ensure that individuals with motor disabilities can fully enjoy their beach experience. This includes accessible parking, restrooms, and pathways. Additionally, the integration of people with disabilities into public services is essential to prevent discrimination and ensure equal access to tourism amenities (Mayordomo-Martínez et al., 2019).

Amenities and Beach Tourism

Amenities play a crucial role in shaping tourists' experiences at beach destinations. Frampton (2010) defined amenities as the facilities and services that provide positive and enjoyable benefits to beach users. Boto-García and Leoni (2023) underscored the importance of coastal amenities, such as restrooms, showers, changing facilities, and beach furniture, in enhancing the overall visitor experience. Recent studies have highlighted the growing importance of infrastructure and amenities. Well-maintained facilities, including accommodation, dining, and transportation options, enhance the overall tourist experience. Furthermore, the availability of technology-driven services, such as Wi-Fi and digital information platforms, has become a crucial factor in attracting tech-savvy travelers (D'Souza & D'Souza, 2023).

Safety is a key concern for beachgoers, and smart beach management can help address this issue. Chen and Teng (2016) noted that safety measures, such as surveillance systems and lifeguards, are essential components of beach amenities that contribute to tourists' sense of security. Alam et al. (2017) further highlighted the role of IoT-based systems in tracking

beach visitors and monitoring safety conditions, which can help authorities manage crowd density and respond promptly to emergencies. Ensuring accessibility and inclusivity is essential for creating a welcoming environment for all visitors. This includes providing facilities for individuals with disabilities and promoting cultural sensitivity. Smart technologies can help to improve accessibility by providing real-time information and navigation assistance for visitors with disabilities (Chang et al., 2022).

Therefore the provision of amenities and the prioritization of safety, sustainability, accessibility, and inclusivity are essential for the success of beach tourism destinations. By investing in infrastructure, technology, and responsible practices, destinations can create a more appealing and enjoyable experience for visitors, fostering long-term sustainability and economic growth.

Activities in Beach Tourism

Water sports and adventure activities are among the most popular attractions for beach tourists, providing exhilarating experiences that attract thrill-seekers (Nagi et al., 2021). Activities such as scuba diving, parasailing, and jet skiing cater to a variety of interests and skill levels, ensuring that there is something for everyone. For example, destinations like Goa offer unique experiences such as sunset kayaking at Mandrem Beach and flyboarding at Morjim, allowing adventurers to interact dynamically with the ocean. These activities not only enhance the excitement of beach tourism but also foster camaraderie among participants. The combination of adrenaline and stunning coastal views creates memorable experiences, making water sports a key component of smart beach tourism.

Incorporating wellness and relaxation activities is equally important for a balanced beach experience (Smith, 2021). Many modern beach destinations emphasize wellness through yoga classes, spa treatments, and meditation sessions, often set against the calming backdrop of the ocean. For instance, beachfront yoga sessions offer guests the opportunity to practice mindfulness while enjoying serene views of the horizon. This focus on wellness complements the adrenaline of water sports and promotes mental and physical well-being, making it a crucial aspect of a holistic beach tourism experience.

Cultural and culinary experiences at the beach further enrich the tourism experience by allowing visitors to immerse themselves in local traditions and flavors (Villagómez-Buele et al., 2020). Beach destinations often feature cultural events such as music performances, dance shows, and art exhibitions that highlight regional heritage (Baixinho et al., 2020). Culinary experiences, including gourmet walking tours and cooking classes, provide opportunities to explore local cuisine and discover hidden gems among restaurants (Yiğit, 2022). Engaging in activities like fishing can deepen the cultural connection and offer insights into the local way of life. By integrating these experiences, tourists not only enjoy the natural beauty of the beach but also create lasting memories that celebrate local culture and community.

The diversity and quality of recreational activities available at a beach destination significantly influence tourist satisfaction and destination competitiveness. Needham and Szuster (2011) emphasized the importance of offering a variety of activities, such as swimming, surfing, and fishing, to cater to different tourist segments. According to Tonmoy, et al., (2020) to enhance the effectiveness of these activities within a smart destination framework, real-time monitoring and data analytics can play a crucial role. Pascoe (2019) highlighted that managing recreational carrying capacity is essential to prevent overcrowding and environmental degradation. Smart management practices, including real-time monitoring of visitor numbers and data-driven optimization of tourist distribution, are vital for maintaining the quality of the beach experience and ensuring sustainable beach tourism.

Available Packages and Beach Tourism

Tourism packages have traditionally been a popular method for travelers to plan and book their vacations, offering a convenient way to access multiple services under one package (Liao & Chuang, 2020). However, the rapid advancement of technology and the growing complexity of tourism products have created the need for innovative approaches to package design and delivery, particularly in the context of smart beach tourism. Pantiyasa et al. (2020) defined tour packages as comprehensive services offered to tourists, typically including transportation, accommodation, and activities, with a focus on enhancing tourist satisfaction through tailored experiences.

In the realm of smart beach tourism, leveraging technology to design, customize, and deliver tourism packages becomes essential. Pröll et al. (1999) emphasized the need for tourism information systems that can manage this complexity by offering a range of services from basic information to fully customized holiday packages. However, challenges remain in achieving seamless integration of these packages into destination information systems and providing direct, user-friendly search facilities.

Destination marketers should prioritize creating effective tourism packages that address tourists' specific needs, expectations, and concerns in a smart tourism context (Piya et al., 2023). Utilizing real-time data and digital platforms, unique offers such as guided services, organized tours, and special interest activities can be dynamically tailored to attract visitors' attention (Arif et al., 2019). For instance, smart beach applications can allow tourists to build customized packages that include a combination of water sports, wellness activities, and cultural experiences based on real-time availability and weather conditions.

Smart packaging solutions also guide tourists in selecting tourism products that best fit their preferences and provide competitive advantages for destinations (Fereidouni & Alizadeh, 2020). Dynamic packaging approaches, which use smart technologies to customize packages based on real-time data and tourist behavior, can significantly enhance tourist satisfaction and engagement (Bruinsma et al., 2011). By integrating various elements of the smart beach environment, such as smart parking, safety alerts, and real-time activity updates, destinations can create more responsive and personalized tourism packages.

Research has consistently shown that the successful integration of tourism packages can improve tourist satisfaction, particularly when they are designed using smart technologies (Bruinsma et al., 2011; Pantiyasa et al., 2020). Ariya et al (2017) highlighted that well-designed tour packaging is effective in attracting tourists, especially when it combines convenience, value, and tailored experiences. In the context of smart beach tourism, this means using digital platforms to dynamically adapt and market packages that enhance the visitor experience while promoting sustainability.

By leveraging smart technologies, destination marketers can create more effective and sustainable tourism packages. These packages not only meet tourists' evolving needs and preferences but also contribute to the efficient management of beach destinations, reducing overcrowding, improving resource use, and enhancing overall tourist satisfaction. In this way, smart packaging strategies are integral to the development of sustainable and competitive smart beach tourism destinations.

Ancillary Services and Beach Tourism

Ancillary services, which encompass a range of public facilities that support tourism activities, play a critical role in enhancing the beach tourism experience (Salam et al., 2018). In the context of smart beach tourism, these services are increasingly integrated with digital technologies to improve accessibility, safety, and overall tourist satisfaction. Öztüren et al. (2021) emphasized that for any tourism activity to thrive, an essential infrastructure must be in place, including hotels, restaurants, bars, shops, parks, and marinas. Within a smart beach framework, these facilities are enhanced by smart systems that provide real-time information and interactive services to tourists, ensuring a seamless and engaging experience.

As tourists often seek entertainment and active engagement during their visits, they require up-to-date information about ancillary services at their destinations (Camilleri et al., 2018). Smart beach tourism leverages digital platforms to provide tourists with real-time data on the availability and quality of these services, such as nearby dining options, retail outlets, public restrooms, and other amenities. Liew et al. (2021) highlighted that ancillary services are crucial for improving tourist satisfaction and can serve as a competitive advantage for tourist destinations. Particularly, services related to safety and emergency medical support are critical components that are highly valued by tourists, making them essential for the success of smart beach destinations.

Camilleri et al. (2018) noted that tourists on vacation desire amusement and entertainment, and access to timely and relevant information about ancillary services is vital. In a smart beach context, this could involve the use of mobile apps or digital kiosks that offer information about local events, guided tours, and entertainment options, thereby enhancing the tourist experience. Tukamushaba et al. (2016) found that ancillary services, as a core component of the tourism product, positively affect memorable travel experiences. They suggested that providing a diverse range of high-quality ancillary services, such as enhanced security measures and reliable internet connectivity, can significantly elevate the comfort and satisfaction of tourists.

Salam et al. (2018) further stressed the importance of having well-maintained public facilities, such as police stations, hospitals, and cleanliness of public areas, to meet the standards expected by tourists. In smart beach tourism, integrating these services with smart technology—such as emergency notification systems, real-time crowd management solutions, and health monitoring facilities—can ensure higher safety and comfort standards for tourists. Muthuraman et al. (2019) also pointed out that although ancillary services are generally daily-use amenities not solely aimed at tourists, they play a vital role in fostering destination competitiveness and enhancing the overall tourism experience.

Smart beach tourism can significantly benefit from optimizing ancillary services through digital tools and smart infrastructure. For example, implementing smart parking systems, real-time updates on public transportation, and digital guides for local attractions and facilities can improve both the operational efficiency of tourism destinations and visitor satisfaction. By creating a more connected and responsive environment, smart ancillary services can enhance tourists' convenience, safety, and enjoyment, making them an essential aspect of sustainable and competitive beach tourism.

III. DISCUSSION AND IMPLICATIONS

The primary aim of this study is to enhance beach tourism by equipping the industry with 'Smart Beach Parameters,' thereby improving the overall tourist experience and contributing to effective smart beach planning and management. This goal aligns with the need for advanced systems capable of real-time data capture, analysis, and interpretation, as emphasized by Sigalat-Signes et al. (2020). The current literature reveals a significant gap in effective beach assessment methods (Tian et al., 2013), highlighting a need for intelligent systems that can deliver real-time

information to public authorities and operators. Alam et al. (2017) stress that timely dissemination of data can enable rapid responses during critical situations, thereby improving beach management and safety.

Chen and Teng (2016) underscore the importance of providing comprehensive beach information through various channels, such as signage, maps, brochures, websites, and apps. Such information empowers tourists to make informed decisions and avoid potential hazards. The integration of smart technologies can further enhance this process by providing real-time updates on local traffic, weather conditions, and available amenities. Girau et al. (2018) advocate for the development of smart beach applications that offer real-time information on beach conditions, crowd density, and other relevant factors, enabling tourists to adjust their plans accordingly and avoid overcrowded areas.

A critical aspect of effective beach management is addressing factors such as access points, parking availability, and carrying capacity. Rajan et al. (2013) highlight the necessity of incorporating sustainable development practices in tourism to maintain a high-quality beach experience. A mobile application combined with a web interface, as proposed by Alam et al. (2017), could facilitate real-time updates on smart parking, weather conditions, and safety measures. This approach can help manage beach crowds, enhance visitor satisfaction, and mitigate potential issues related to overcrowding and environmental impact.

The lack of a coherent development strategy and unplanned growth, as identified by Ghosh and Datta (2017), often undermine long-term sustainability efforts. Therefore, a comprehensive framework that integrates various activities and emphasizes sustainable development is crucial for effective beach tourism management. Developing such a framework will address the challenges of coastal and beach tourism and create a more resilient and enjoyable experience for visitors (Ghosh, 2011).

Adopting smart beach practices and sustainable strategies can significantly improve the management and experience of beach tourism. By leveraging real-time data and integrating advanced technologies, stakeholders can address key challenges, enhance visitor satisfaction, and promote long-term sustainability. Future research should focus on refining smart beach frameworks and exploring their effectiveness in different contexts to support more effective and resilient beach management policies.

IV. RESEARCH GAPS AND FUTURE DIRECTIONS

The review of existing literature reveals several research gaps and areas for future exploration in the context of smart beaches and beach tourism. One significant gap is the limited focus on real-time data applications within smart beach management. While the integration of smart technologies offers the potential for improved visitor experiences and sustainable practices, there is a scarcity of studies examining the real-time application of data for managing beach environments effectively. Existing research often lacks empirical evidence on how real-time data influences tourist satisfaction and decision-making processes.

Another gap is the lack of integrated frameworks that consider multiple facets of beach tourism simultaneously. Although the 6 A's Framework provides a comprehensive approach to analyzing tourism destinations, studies specifically applying this framework to smart beach management are limited. There is a need for frameworks that integrate various components of beach tourism—such as attractions, accessibility, amenities, activities, available packages, and ancillary services—into a cohesive model that can guide smart beach development and management.

Moreover, empirical research on the effectiveness of smart beach strategies is insufficient. While theoretical discussions on smart technologies and sustainable practices are well-established, there is a need for more empirical studies assessing how specific smart solutions impact tourist satisfaction, loyalty, and overall experience. Research should explore how various smart technologies contribute to improved beach management and whether they align with tourists' expectations and preferences.

Future research should focus on developing integrated smart beach management models that incorporate real-time data and consider all aspects of beach tourism. Investigating tourists' perceptions across different regions can provide valuable insights into regional variations and preferences. Additionally, studying the effectiveness of smart solutions in enhancing tourist satisfaction and loyalty will help validate their practical applications and guide future innovations in smart beach management.

By addressing these gaps, future studies can contribute to more effective and sustainable beach tourism practices, enhancing both the visitor experience and the ecological health of coastal destinations.

V. CONCLUSION

The literature reviewed underscores the evolving dynamics of beach tourism and the increasing need for adopting smart and sustainable practices to enhance both tourist experiences and environmental management. Key findings from the literature highlight several critical aspects:

Firstly, the importance of integrating smart technologies into beach management is increasingly recognized. Smart beaches, characterized by the use of real-time data, digital tools, and advanced monitoring systems, offer significant potential for addressing common issues such as overcrowding, environmental degradation, and resource inefficiency. Studies have

shown that smart technologies can facilitate more effective crowd management, improve safety, and enhance the overall visitor experience by providing real-time information on beach conditions, amenities, and accessibility.

Secondly, the 6 A's Framework—Attractions, Accessibilities, Amenities, Activities, Available Packages, and Ancillary Services—provides a comprehensive approach to understanding and managing beach tourism. This framework emphasizes the need for a balanced consideration of various aspects of beach destinations to optimize tourist satisfaction and ensure sustainable practices. The literature indicates that effective management of these elements is crucial for maintaining the attractiveness and functionality of beach destinations.

The review also highlights the growing recognition of the multidimensional nature of beach environments and the necessity for tailored management strategies. Beaches are dynamic spaces where natural and human factors interplay, making it essential to develop smart management practices that address specific local challenges while promoting sustainability.

Despite these advancements, there is a notable gap in empirical research on the practical effectiveness of smart beach strategies. Much of the current literature is theoretical, with limited empirical evidence assessing the real-world impact of smart technologies on tourist satisfaction and environmental outcomes. Future research should focus on filling these gaps by developing integrated models for smart beach management and conducting empirical studies to evaluate the effectiveness of smart solutions in diverse beach settings.

The adoption of smart beach practices and sustainable strategies is vital for the future of beach tourism. These approaches not only enhance the tourist experience but also contribute to the preservation of beach environments. Comprehensive research is needed to support the development of effective smart beach management policies and to provide evidence-based recommendations for improving beach tourism sustainability. By addressing these research gaps, stakeholders can better align technological advancements with the needs and preferences of tourists, leading to more effective and sustainable beach management practices.

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