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Advancing Beach Tourism: The Role of Smart Technology in Enhancing Attractiveness

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Abstract

This study explores the implementation of Smart Beach Parameters in Goa's tourism industry to enhance the beach experience and support effective management and planning. As tourism evolves globally, the integration of information and communication technologies (ICT) is crucial for sustaining competitiveness and promoting sustainable development. The research aims to develop a tailored Smart Tourism Destination Scale for Goa, focusing on five key factors—Amenities, Accessibility, Activities, Available Packages, and Ancillary Services—and their impact on the Attractiveness of beach destinations. A mixed-method approach, including a primary field survey, semi-structured interviews, participatory observation, and data analysis through SPSS, was employed to assess the significance of these factors. Findings indicate that Amenities, Accessibility, and Activities are pivotal in enhancing beach attractiveness, while Available Packages and Ancillary Services contribute to overall tourist satisfaction. The results provide practical insights for improving beach tourism management in Goa, offering a framework for integrating smart solutions that can attract both domestic and international tourists. The implications emphasize the need for dynamic technological platforms to improve beach management and tourist experiences. Future research is recommended to validate the developed scale using Confirmatory Factor Analysis (CFA) and explore the integration of emerging technologies like AI, AR, and VR. This study contributes to the theoretical understanding of smart tourism and provides actionable recommendations for enhancing the sustainability and competitiveness of beach destinations.

Keywords: *Smart Beaches, Tourism Management, Goa, Smart Tourism Destination Scale, Real-Time Data, Sustainable Development*

Introduction

Tourism in Goa, India, has seen remarkable growth, establishing itself as a significant economic sector in the state. The region's natural coastal beauty, rich history, and the warmth of its people have positioned Goa as an attractive domestic and international tourist destination. The rapid development of accommodation venues, transport systems, shopping centers, restaurants, and recreational facilities reflects the state's response to the influx of global tourists

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(Dessai, 2023). Among the diverse offerings, beaches have emerged as key attractions, renowned for leisure and a variety of exciting activities (Alam et al., 2017). Despite their appeal, these beaches face challenges related to connectivity and information dissemination.

Issues such as limited real-time information about beach population density, access to nearby amenities, parking space availability, public transportation, weather forecasts, and medical emergency facilities hinder the overall beach experience. North and South Goa beaches, known for their attractiveness and recreational opportunities, are particularly affected by these connectivity challenges. The rapid growth of beach tourism has brought about both development and problems, including traffic congestion, illegal coastal construction, pollution, and inadequate public infrastructure (Achrekar, 2022). Rajan et al. (2013) emphasize that effective beach management is crucial for sustaining tourist attraction, highlighting the importance of addressing planning and management issues through a sustainable development approach.

Beach tourism, with its promise of unique experiences, attracts tourists seeking novel opportunities (Sahoo, 2014). Chen and Teng (2016) argue that providing comprehensive beach-related information—through signage, maps, brochures, websites, or apps—is essential for keeping potential tourists well-informed. Sahoo (2014) further stresses the need to evaluate beach tourism attributes such as connectivity and hotel occupancy. Effective development strategies are crucial as tourism service providers face challenges related to advancements in ICT, transportation technology, and changes in travel dynamics (Dwyer, 2017).

The challenge of developing beach tourism without overburdening existing infrastructure is significant. Common issues include limited resources, dependency on external development assistance, poor infrastructure, urbanization, vulnerability to natural disasters, and the impacts of climate change (Dwyer, 2017). Addressing these challenges while enhancing the beach experience requires innovative solutions that integrate smart tourism concepts and real-time information systems.

This study focuses on developing a Smart Tourism Destination Scale for Goa's beaches, aiming to improve the overall beach experience by providing real-time, actionable information. By addressing the identified gaps in connectivity and information dissemination, this research intends to enhance the attractiveness and sustainability of Goa's beach destinations. The integration of smart tourism concepts into beach management can contribute to more informed decision-making, better resource allocation, and an overall improved tourist experience.

Literature revew

The growth and popularity of beach tourism have led to the increased need for practical and sustainable practices to address issues such as overcrowding, sand loss, habitat destruction, water pollution, and littering resulting from the booming beach activities (Chen & Teng, 2016). Yang et al. (2021) and Hailuddin et al. (2022) highlighted that beaches make a valuable economic contribution to tourist destinations, being key resources in tourism. To mitigate the detrimental effects of rising beach tourism on ecological status and recreational experiences, it is crucial to adopt sustainable and smart practices to preserve the significant values generated from beach tourism (Gomis-López et al., 2020).

Beaches are inherently multidimensional environments, each with its unique characteristics and challenges arising from varying levels of human use (Bombana et al., 2021). This multidimensional nature necessitates focused attention on the parameters that influence beach tourism experiences, requiring smart interventions and specific management strategies.

Effective management is vital for high-demand and high-use beaches to balance visitor numbers with the quality of the beach experience (Chen & Teng, 2016). Evidence suggests that domestic and international tourists perceive destination images differently due to variations in travel motivations, destination choice, activity selection, trip expectations, and satisfaction levels (Rutty & Scott, 2016). Despite the documented issues of overcrowding, littering, and environmental degradation, research has shown limited focus on the impacts of beach recreation, even though it generates substantial economic benefits (Yang et al., 2021; Suman & Kumar, 2023). Given the critical role of beaches in the tourism market, proactive measures are needed to consider tourists' needs, perceptions, and preferences regarding beach quality to develop better-informed and smart management processes.

With the increasing use of beach areas, changes in natural resources and visitor experiences are inevitable, necessitating the provision of pertinent and measurable information indicators (Chen & Teng, 2016). More comprehensive approaches that incorporate various stakeholders' perspectives are lacking, and tourists' views are often underrepresented (da Costa Liberato et al., 2018). While smart destination policies aim to enhance tourist experiences and improve destination management processes, the real effects of these policies remain largely unknown (Buhalis & Amaranggana, 2013). The concept of an interconnected future, where information is collected, measured, processed, and analyzed to enhance resource efficiency and service quality, is key to informed decision-making (Sigalat-Signes et al., 2020). Smart destinations are increasingly recognized as a viable management approach based on ICT-driven interactions, contributing to enhanced tourist experiences (Buhalis & Amaranggana, 2013).

6 A's Framework for the Analysis of the Tourism Destination

According to Buhalis and Amaranggana (2013), to become a successful destination and maintain high competitiveness, it is crucial for a destination to effectively manage the 6 A's of tourism: Attractions, Accessibility, Amenities, Activities, Available Packages, and Ancillary Services.

Attraction

Botero et al. (2018) highlighted that an attraction consists of both artificial and natural features that geographically draw people to provide them with a recreational experience. Matthews et al. (2018) noted that destination choices are influenced by the spatial distribution of sites and attractions, and that these choices collectively determine the demand for beach recreation. To sustain destination attractiveness, pre-planning for tourism development is essential given the demand for various destinations (Öztüren et al., 2021). Pascoe (2019) emphasized that recreational activities such as swimming, fishing, surfing, walking, or simply enjoying the seaside are popular among beach visitors.

Tourist activities are often climate-dependent, particularly in warm destinations. Data on favorable weather conditions can significantly influence the decision to visit a beach. There is a strong relationship between weather conditions and tourism, with weather often acting as a push factor for specific destinations (Rosselló & Waqas, 2016). Assessing the effects of weather on tourism destinations is crucial for tourism organizations to provide strategic information to tourists (Rutty & Scott, 2014). Hansen et al. (2010) argued for the need to enhance the resilience of systems to climate change and to develop climate-smart conservation frameworks.

Beach tourism activities such as sunbathing and swimming are more strongly linked to specific weather conditions compared to other tourism activities (Perch-Nielsen, 2010).

Amenities

Historically, beach management focused primarily on coastal defense and often overlooked the full amenity value of beaches, including their multifaceted roles in enhancing recreation and aesthetic experiences. Frampton (2010) defined amenity as a perception of beach users that provides positive and enjoyable benefits. Understanding the perceived amenities of a beach through surveys is essential for effective beach management. Coastal amenities are significant attractions for tourism activities (Boto-García & Leoni, 2023). Real-time information on amenities is valuable for authorities responsible for beach area maintenance and management. Girau et al. (2018) proposed a system architecture for monitoring beaches to address critical issues such as human surveillance for safety purposes and crowd management. Live crowd management can improve tourists' beach experiences by enhancing security.

Safety, a major concern for tourists, often lacks adequate attention regarding safe access to and the creation of secure beach spaces (Chen & Teng, 2016). Alam et al. (2017) observed that recent tourism growth has spurred efforts to introduce intelligence for solving essential problems like surveillance for safety. They noted that tracking and storing the number of beach visitors in a database could provide insights into tourist density across different beach areas, thereby enhancing beach safety.

Accessibility

Accessibility issues often include traffic jams, lack of parking space, and inadequate traffic signage. Additionally, facilities such as parking and restrooms are sometimes occupied by local entrepreneurs and shop owners, leaving tourists frustrated (Polnyotee & Thadaniti, 2015). Real-time information on parking availability can significantly reduce the time tourists spend searching for parking, thus alleviating traffic congestion at beach areas (Alam et al., 2017). Girau et al. (2018) emphasized the need for systems to monitor and manage traffic congestion to improve beach accessibility.

Kammler and Schernewski (2004) suggested that webcam monitoring provides an efficient method for permanent observation of beach visitor density and behavior. Alam et al. (2017) focused on enabling cooperative sensing within the Internet of Things (IoT) for smart beaches and intelligent transportation systems, using big data for safety, traffic, and congestion management. They proposed implementing smart parking systems with sensors to provide real-time information about available and occupied parking spaces. Lack of territorial cohesion in regional transport often leads to private vehicles becoming the primary mode of transport, exacerbating traffic congestion and pollution, particularly during peak seasons, which significantly affects beach destinations (Sigalat-Signes et al., 2020). Alam et al. (2017) demonstrated that adopting smart beach practices, such as disseminating real-time warnings about wrong-way driving, traffic jams, accidents, roadwork, and alternate routes, can mitigate these issues. Mayordomo-Martínez et al. (2019, June) highlighted the importance of accessibility and inclusivity of tourism resources to improve enjoyment and well-being for individuals with motor disabilities, particularly at beaches, which are major tourist attractions. Their subsequent re-

search emphasized the need for integrating people with disabilities into accessibility planning to prevent exclusion from public services (Mayordomo-Martínez et al., 2019, July).

Activities

Needham and Szuster (2011) stressed the importance of providing open spaces and opportunities for increasing coastal tourism and recreational activities. Tourists often engage in various activities, including shopping, dining out, and participating in outdoor recreational pursuits (D'Souza, 2024; Camilleri & Camilleri, 2018). To effectively manage recreation ecosystem services, it is crucial to consider how these services are perceived by visitors. As beach recreation intensifies, the quality of the beach experience and enjoyment for users may diminish (Rajan et al., 2013). Recreational carrying capacity is the maximum level of development and activity a body of water can handle before degradation occurs (Aliyeva et al., 2020). Thus, adopting a smart approach to redefine beach tourism development on a sustainable basis is necessary. The technological revolution and growth of ICT in the tourism sector highlight the importance of investing in technological applications to enhance tourism services (Sigalat-Signes et al., 2020).

Available Packages

Pröll et al. (1999) described the complexity of tourism products and emphasized that holiday packages should be supported by a tourism information system, ranging from basic information to consumer-defined packages. However, they noted a lack of seamless integration of packages into destination information and a direct search facility for available packages. Destination marketers should focus on creating effective tourism packages that address tourists' expectations, needs, and concerns (Irigüler & Güler, 2016). Available packages often include guiding services, organized tours, and special interest tours, which can attract visitors' attention. Arif et al. (2020) noted that the available packages component involves a combination of various services in a single tour package to offer to visitors.

Cardoso and Lange (2007) stated that packages help customers select tourism products and that dynamic packaging can be used as a competitive advantage, customized according to tourists' requirements. Bruinsma et al. (2011) found that successful integration of tourism packages with various services enhances tourist satisfaction. Pantiyasa et al. (2020) examined tourist satisfaction with tour packages, defining them as services comprising trips and focusing on tourists' satisfaction with these packages. Kumar et al. (2020) highlighted the necessity of special stimulus packages from government tourism departments to sustain and revive the travel and tourism industry post-pandemic. Liao and Chuang (2020) focused on the development of tour packages, concluding that effective package creation, which combines various elements of travel experiences, is crucial for attracting tourists.

Ancillary Services

Ancillary services are described as the availability of public facilities that support the implementation of tourism activities, including banks, ATMs, hospitals, and other amenities used by tourists. Öztüren et al., (2021) stated that for tourism activities to flourish, essential infra-

structure and facilities such as hotels, restaurants, bars, shops, parks, and marinas are required. Tourists often seek amusement, entertainment, and active experiences during their visits, necessitating access to information about ancillary services at their destinations (Camilleri & Camilleri, 2018). Liew et al. (2021) revealed that ancillary services are crucial attributes for tourism industry practitioners to consider in order to enhance tourist satisfaction and develop a competitive advantage over other destinations. Specifically, safety of tourism attractions and emergency medical services were identified as highly significant by respondents in their study. Camilleri and Camilleri (2018) noted that tourists on vacation generally seek to be amused, entertained, and active, making information about ancillary services vital. Tukamushaba et al. (2016) found that ancillary services, as a component of the tourism product, positively impact memorable travel experiences. They emphasized that providing excellent ancillary services, such as security and internet access, contributes to a more comfortable stay for tourists. Salam et al. (2018) highlighted that improving tourism destination management and meeting service standards require the provision of services such as police stations, hospitals, and well-maintained public facilities, including those for safety, security, and health standards. Muthuraman et al. (2019) further asserted that ancillary services, while often considered daily use amenities rather than tourist-specific services, are critical for enhancing destination competitiveness and adding value to the tourist experience.

Despite the considerable literature on the 6A's framework in tourism (Buhalis & Amaranggana, 2013), there is a lack of studies focusing specifically on beach destinations and how tourists prioritize these factors. Previous research has extensively discussed individual aspects of beach management, such as safety (Chen & Teng, 2016), accessibility (Polnyotee & Thadaniti, 2015), and amenities (Frampton, 2010), but there has been limited focus on an integrated approach that considers the combined effect of *Amenities, Accessibility, Activities, Available Packages, and Ancillary Services* on a destination's overall *Attractiveness*. Moreover, most studies either emphasize infrastructural improvements (Alam et al., 2017) or the role of tourism packages (Arif et al., 2019), but they do not provide a comprehensive analysis of how tourists rank these factors in their decision-making process. This study aims to fill these research gaps by analyzing the relative importance of each factor using the 6A's framework and determining how they collectively influence beach *Attractiveness*.

The primary objectives of this study are twofold. First, it aims to develop a Smart Tourism Destination Scale tailored to Goa's tourism industry. This new scale is designed to equip Goa's tourism sector with tools to enhance the overall beach experience for tourists, making it a more efficient, safe, and enjoyable destination. By integrating smart tourism concepts, the research intends to contribute to the sustainable development and long-term attractiveness of Goa's beach destinations.

Secondly, the study aims to assess the relationship between the five key factors—*Amenities, Accessibility, Activities, Available Packages, and Ancillary Services*—and their contribution to the *Attractiveness* of beach destinations. Specifically, the study seeks to identify the factors that tourists prioritize the most when visiting beach destinations, providing actionable insights for policymakers and tourism managers to optimize services and facilities. Furthermore, this study investigates whether there is a significant difference in the prioritization of the six factors—*Amenities, Activities, Attractions, Accessibility, Available Packages, and Ancillary Services*—by tourists, highlighting potential variations in their preferences and offering a deeper understanding of what drives beach tourism competitiveness

Building upon the objectives and research gaps identified, this study formulates the following hypotheses to guide the analysis of how tourists prioritize the six factors (Amenities, Activi-

ties, Attractions, Accessibility, Available Packages, and Ancillary Services) and their impact on the attractiveness of beach destinations, particularly in Goa:
H_1: There is a significant difference in the priorities of the six factors (Amenities, Activities, Attractions, Accessibility, Available Packages, and Ancillary Services) by tourists at beach destinations.
H_2: *Amenities* have a significant effect on the overall *Attractiveness* of beach destinations.
H_3: *Activities* play a significant role in enhancing the *Attractiveness* of beach destinations.
H_4: *Accessibility* significantly impacts the *Attractiveness* of beach destinations, particularly in relation to traffic management and real-time access to facilities.
H_5: *Available Packages* contribute significantly to the overall appeal of a beach destination by offering tailored tourism experiences.
H_6: *Ancillary Services* (such as safety, medical facilities, and security) have a significant positive influence on tourist satisfaction and beach *Attractiveness*.

These hypotheses will be tested through data collection and analysis, aiming to provide deeper insights into tourists' preferences and the key drivers of beach attractiveness. The findings will not only validate the 6A's framework but also offer actionable recommendations for the development of smart beach strategies that align with tourists' expectations and enhance Goa's tourism appeal.

Methodology

This research focuses on the beach tourism sector in Goa, India, with an emphasis on integrating smart beach concepts for real-time information dissemination. The study employs a combination of field-level assessments and theoretical-conceptual approaches to understand and enhance beach tourism experiences.
An exploratory research design was adopted, involving a comprehensive field survey to identify significant characteristics of the beaches in Goa. The study included an onsite field visit to both North Goa and South Goa beaches to assess their current state and gather relevant data.
A primary data collection instrument was developed in the form of a questionnaire, which included semi-structured and multiple-choice questions rated on a five-point Likert scale. The questionnaire was designed based on the six parameters of Smart Tourism Destinations proposed by Dimitrios Buhalis. The questions were crafted to capture tourists' perspectives on various aspects of beach tourism amenable to real-time information dissemination and their impact on the overall beach experience. To ensure the content validity of the scale, expert evaluations were conducted. Subject matter experts reviewed the questionnaire to confirm that it accurately measured the intended constructs related to smart tourism and beach management. To ensure the clarity and effectiveness of the questionnaire, a pilot study was conducted with tourists from different regions of India. This preliminary phase allowed for testing the questionnaire's comprehensibility and making necessary revisions to simplify it for broader understanding.
The final questionnaire comprised two sections: the first section collected data on visitor/tourist profiles, while the second section focused on their responses regarding the beach tourism experience.In addition to the survey, in-depth interviews were conducted with restaurateurs, industry experts, locals, and tourists to gain qualitative insights. Participatory observation was also employed to supplement the survey data.

The sample consisted of 103 tourists who visited popular beaches in Goa. Convenience and snowball sampling methods were utilized to gather responses. The collected data was organized, tabulated, and analyzed using SPSS software.

Data Analysis / Results

Demographic variables (gender, age, travelling with, mode of transportation and travelling through) of the study are given in Table 1.

Table 1. Demographic variables of the study

Demographic Variables		Frequency	Percentage%
Gender	Male	51	49.5
	Female	52	50.5
Age	15-25	19	18.4
	26-35	43	41.7
	36-45	23	22.3
	46 and above	18	17.5
Travelling With	Solo	12	11.7
	With Friends	33	32.0
	With Family	54	52.4
	Others	4	3.9
	Total	103	100.0
Mode of Transportation	Air	44	42.7
	Rail	11	10.7
	Road-Bus	6	5.8
	Road-Own Vehicle	41	39.8
	Road-Hired vehicle	1	1.0
	Total	103	100.0
Travelling Through	Pre-designed Tour & Travel Package	2	1.9
	Customized or Tailor-Made Package	9	8.7
	Own Travel Itinerary	79	76.7
	Other	13	12.6
	Total	103	100.0

Source: Own study

An Exploratory factor analysis of all the items was conducted in order to reduce the number of items and to check the factor loadings. A varimax rotated principal component analysis was used on 45 items for a sample of 103 tourists. KaiserMeyer-Olkin statistics of 0.800 and Bartlett's test of Sphericity statistics of 5998.186 indicated that the data was suitable for conducting factor analysis (Norusis/SPSS Inc., 1988). Three of items did not load as their values were below .500. A six-factor solution was obtained on the basis of minimum eigen value of one and the interpretability of the solution. These factors cumulatively explained 79 % of the variance in the original data set. Table 2 shows Rotated Component Matrix and factor loadings.

Table 2. Factor loadings and Cronbach's Alpha

Items	Factors					
	1	2	3	4	5	6
The beach is pleasant	0.845					
There is an adequate public washroom at the beach	0.944					
There are adequate number of garbage disposal bins at the beach	0.842					
There is adequate internet connectivity at the beach						
There is provision for adequate safe drinking water at the beach	0.807					
There is provision for adequate outdoor showers at the beach	0.746					
Adequate shower facility is available in the washroom at the beach area	0.704					
Adequate changing rooms for men & women are available at the beach	0.854					
Adequate restaurants & eateries are available at the beach	0.668					
There is an adequate play area for kids at the beach area	0.929					
I feel safe at the beach	0.846					
Lifeguards are adequately staffed at the beach	0.797					
The roads at the beach are well maintained				0.839		
There is adequate public transportation to & from the beach				0.731		
There are sidewalks near the beach area for the pedestrians/ tourists to walk comfortably				0.579		
There is adequate parking at the beach				0.875		
The parking at the beach is safe				0.655		
There is special washroom facility for differently abled citizens				0.785		
There is ramp facility for differently abled citizens				0.867		
There are adequate signages & boards for proper navigation to the beach				0.605		
The beach is easily accessible given my physical condition(Eg. Senior citizen, any medical condition)						
There is adequate space at the beach to do all kinds of beach activities		0.791				
The overall appearance of the beach is attractive		0.782				
Adequate information on the beach weather condition is available		0.731				
The beach water is clean for recreational activities		0.880				
The beach water is safe for recreational activities		0.798				
The beach is well maintained for cleanliness		0.765				

The design of the beach is visually attractive		0.871				
There is adequate crowd management at the beach						
The Beach water is adequately clean to swim			0.651			
Adequate information on safety of beach water is available for swiming purpose (Eg.quality/current/temperature/presence of harmful sea species in the water)			0.818			
Adequate information on how to use the safety/protection gears/equipments are available for boating activity			0.727			
Adequate information along with clear instructions on other beach adventure activities are provided			0.826			
Water activities are well organized			0.846			
Adequate information for booking the beach activities/water sports activities in advance is available			0.812			
All beach related activities are adequately monitored & supervised			0.872			
Multiple modes of payment such as online payment through Netbanking, Google Pay, Phonepay, Paytm etc., are available at the beach for all the beach activities			0.683			
Adequate information on Goa's beach destination packages are available					0.740	
Adequate information on packages inclusive of all water sports/ beach activities is available					0.887	
Available packages are inclusive of adequate information on hotels/accommodations & restaurants					0.795	
Visiting a beach destination without the travel package is more convenient					0.715	
Available packages provide adequate choices					0.801	
Available packages help in making a more informed decision					0.880	
Adequate emergency medical facility is available at the beach						0.929
I'm aware of fire station at the beach area						0.919
I'm aware of police station at the beach area						0.849
Adequate shopping options are available at the beach area						0.697
Adequate number of beach shacks are available						0.782
Cronbach's Alpha	.958	.955	.952	.932	.931	.946

Extraction Method: Principal Component Analysis.
Rotation Method: Varimax with Kaiser Normalization.

The results of the Principal Component Analysis (PCA) with Varimax rotation revealed six distinct factors representing key dimensions of beach tourism: Amenities, Attractions, Activities, Accessibility, Available Packages, and Ancillary Services. Each factor displayed high internal consistency, as indicated by Cronbach's Alpha values ranging from 0.931 to 0.958. Amenities emerged as the most significant factor, capturing various aspects such as the availability of

public washrooms, garbage disposal bins, safety measures, and restaurants. Attractions focused on the natural and artificial features that draw tourists, including cleanliness, visual appeal, and crowd management. Activities centered around recreational opportunities and their organization, safety, and accessibility. Accessibility highlighted the importance of transportation infrastructure, facilities for differently-abled tourists, and well-maintained roads. Available Packages included elements related to the variety and comprehensiveness of beach tourism packages, aiding tourists in making informed decisions. Ancillary Services covered supporting facilities such as emergency medical services, fire stations, and shopping options. Together, these six factors provide a comprehensive framework for understanding the components that significantly influence tourist experiences and satisfaction in beach tourism destinations. It is worth noting that three items did not load onto any factor as their factor loadings were below 0.5, indicating they do not strongly associate with any of the identified dimensions.

Friedman's Test is a non-parametric statistical test used to detect differences in the rankings of several related groups. It is particularly useful when the assumption of normality is not met for repeated measures data (Conover, 1999). In this study, Friedman's Test was conducted to assess which factors—Amenities, Activities, Attractions, Accessibility, Available Packages, and Ancillary Services—are prioritized more by tourists at beach destinations.

The results of Friedman's Test are summarized in the table provided. The mean ranks for each factor are seen in table 3. The test statistic, Chi-Square (χ^2) = 78.230 with degrees of freedom (df) = 5, and the Asymptotic Significance (p-value) = 0.000. Since the p-value is less than 0.05, it indicates that there is a statistically significant difference in the prioritization of the six factors (Amenities, Activities, Attractions, Accessibility, Available Packages, and Ancillary Services) by tourists when selecting a beach destination.

Table 3. Friedman's Test

Factors	Mean Rank
Amenities	4.42
Activity	3.93
Attraction	3.56
Accessibility	3.55
Available Package	3.12
Ancillary Service	2.42
Test Statistics[a]	
N	103
Chi-Square	78.230
df	5
Asymp. Sig.	0.000
a. Friedman Test	

The results suggest that Amenities is the most prioritized factor by tourists when selecting a beach destination, with the highest mean rank of 4.42, followed by Activities (3.93) and Attractions (3.56). Ancillary Services was the least prioritized factor, with the lowest mean rank of 2.42.

Table 4. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	.649a	.421	.391	.75383
a. Predictors: (Constant), AncillaryServiceC, AmentiesC, AvPackageC, AccessibiityC, ActivityC				

The regression model as seen in Table 4, demonstrates a moderate explanatory power, with around 42.1% of the variance in beach destination attractiveness explained by the predictors. While the model accounts for a significant portion of the variability, there is still 57.9% of the variance that is not explained by the current set of predictors, suggesting that other factors may also influence the Attractiveness of beach destinations.

Table 5. Anova Results

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	40.047	5	8.009	14.095	.000[b]
	Residual	55.122	97	.568		
	Total	95.169	102			
a. Dependent Variable: Attraction						
b. Predictors: (Constant), Ancillary Service, Amenities, Available Package, Accessibility, Activity						

The ANOVA results as seen in Table show that the regression model is statistically significant ($p < 0.001$), suggesting that the independent variables collectively provide a significant explanation of the variability in beach destination attractiveness. The F-statistic of 14.095 further supports the significance of the model, indicating that the model is a good fit for the data.

Table 5. Coefficients Table

Coefficients[a]					
Model	Unstandardized Coefficients		Standardized Coefficients	t	Sig.
	B	Std. Error	Beta		
(Constant)	0.098	0.387		0.254	.004
Amenities	0.276	0.094	0.249	2.933	.001
Activity	0.221	0.106	0.226	2.089	.025
Accessibility	0.241	0.106	0.231	2.271	.000
Available Package	0.195	0.100	0.183	1.942	.055
Ancillary Service	0.346	0.084	0.349	4.127	.000
a. Dependent Variable: Attraction					

The coefficients table provides a detailed analysis of the relationship between various predictors and the attractiveness of beach destinations (Attraction). Here's a breakdown of the results:

Amenities (B = 0.276, Beta = 0.249, t = 2.933, Sig. = 0.001): Amenities have a statistically significant positive effect on the attractiveness of beach destinations. The coefficient indicates that for every unit increase in amenities, the attractiveness of the beach increases by 0.276 units. This finding supports Hypothesis 2, which posits that amenities significantly affect beach attractiveness. The low p-value (0.001) confirms that this relationship is statistically significant.

Activity (B = 0.221, Beta = 0.226, t = 2.089, Sig. = 0.025): Activities also significantly impact the attractiveness of beach destinations. The coefficient suggests that each unit increase in activities contributes to an increase of 0.221 units in beach attractiveness. This supports Hypothesis 3, which states that activities play a significant role in enhancing beach attractiveness. The p-value of 0.025 shows the effect is statistically significant.

Accessibility (B = 0.241, Beta = 0.231, t = 2.271, Sig. = 0.000): Accessibility has a significant positive effect on the attractiveness of beach destinations. The coefficient indicates that an improvement in accessibility increases attractiveness by 0.241 units per unit change. This supports Hypothesis 4, which argues that accessibility significantly impacts beach attractiveness. The p-value (0.000) strongly supports the significance of this effect.

Available Package (B = 0.195, Beta = 0.183, t = 1.942, Sig. = 0.055): The effect of available packages on beach attractiveness is positive but not statistically significant at the conventional 0.05 level. The coefficient suggests that for each unit increase in available packages, attractiveness increases by 0.195 units. Although the p-value is slightly above 0.05 (0.055), which means it is approaching significance, this result suggests that while available packages may contribute to beach attractiveness, the effect is not as strong or clear as with other factors. Thus, Hypothesis 5 is partially supported but does not achieve statistical significance.

Ancillary Service (B = 0.346, Beta = 0.349, t = 4.127, Sig. = 0.000): Ancillary services, such as safety, medical facilities, and security, have a highly significant positive effect on the attractiveness of beach destinations. The coefficient indicates that each unit increase in ancillary services results in a 0.346-unit increase in attractiveness. This strongly supports Hypothesis 6, which states that ancillary services significantly positively influence tourist satisfaction and beach attractiveness. The p-value of 0.000 underscores the robust significance of this effect.

Amenities, activities, accessibility, and ancillary services are shown to significantly enhance the attractiveness of beach destinations, while the effect of available packages is close to significance but not statistically significant at the 0.05 level. These findings validate most of the proposed hypotheses and highlight key areas for improving the overall appeal of beach destinations.

Discussion

This study aimed to enhance Goa's beach tourism by identifying and validating key Smart Beach Parameters that contribute to the attractiveness of beach destinations. The results not only provide valuable insights into the factors influencing beach tourism but also contribute to theoretical understanding and practical management strategies. The analysis highlights the importance of Attractions as the primary dependent variable, followed by other significant factors.

The study's findings underscore the pivotal role of Attractions in determining beach attractiveness. This aligns with previous research that emphasizes the importance of both natural and man-made features in attracting and retaining tourists (Tian et al., 2013). High factor loadings associated with aspects such as beach cleanliness, visual appeal, and crowd management indicate that these elements are crucial in shaping the overall tourist experience. This supports the findings of Girau et al. (2018), who stressed that addressing issues like overcrowding and maintaining visual appeal are essential for enhancing the beach experience.

The high significance of Attractions in this study also reflects the broader theoretical framework of Smart Tourism Destinations, as proposed by Buhalis (2003). This framework highlights the multifaceted nature of tourism experiences and the necessity for integrated management approaches. The focus on Attractions complements the framework by emphasizing that the appeal of beach destinations is strongly influenced by their aesthetic and functional attributes.

Amenities, though crucial, did not emerge as the strongest predictor of beach attractiveness in this study. However, they remain an important aspect, consistent with Chen and Teng's (2016) findings. The presence of essential infrastructure, such as public washrooms, garbage disposal, and safety measures, is fundamental to ensuring a pleasant beach experience. Sigalat-Signes et al. (2020) also support this view, emphasizing that real-time information systems are necessary for maintaining and improving these amenities.

The significance of Activities in enhancing beach attractiveness aligns with Alam et al.'s (2017) and D'Souza's (2024) research, which underscores the role of well-organized recreational opportunities in tourist satisfaction. Although Activities were a significant factor, their impact was less pronounced compared to Attractions. This finding suggests that while activities are important, their effectiveness is often enhanced when integrated with other elements, such as attractive amenities and well-maintained attractions.

Accessibility was identified as a significant factor affecting beach attractiveness. This supports Rajan et al. (2013), who highlighted the importance of transportation infrastructure and facilities for differently-abled tourists. The study's results suggest that improving transportation options, parking availability, and overall accessibility are crucial for enhancing the beach experience. This finding is consistent with the broader trend towards inclusivity in tourism planning.

The impact of Available Packages on beach attractiveness was positive but not statistically significant. This indicates that while well-designed tourism packages can enhance the beach experience, they may not be as impactful as other factors. This finding aligns with Ghosh and Datta's (2017) observation that unplanned growth and lack of strategic development can limit the effectiveness of tourism packages.

Ancillary Services showed a strong positive impact on beach attractiveness. This supports Ghosh (2011), who emphasized the need for comprehensive frameworks that address various aspects of beach tourism, including safety and emergency preparedness. The significance of ancillary services highlights their critical role in ensuring a safe and enjoyable beach experience.

Limitations and Scope for Future Research

This study has several limitations. Firstly, the sample size of 103 respondents, while useful for preliminary insights, may not fully represent the diverse tourist population at Goa's beaches. This limitation affects the generalizability of the findings. Future research should aim for a larger, more diverse sample to enhance the robustness of the results. Additionally, the use of

convenience and snowball sampling methods may introduce biases, potentially over-representing certain tourist groups while under-representing others. Employing more randomized sampling techniques could address this issue.

Another limitation is the reliance on self-reported data, which can be affected by social desirability and recall bias. To address this, future studies should include observational data and secondary sources to complement self-reports. Moreover, the focus on Goa's beaches limits the applicability of the findings to other contexts. Comparative studies across different geographical and cultural settings would help test the generalizability of the results and explore how contextual factors influence tourist preferences.

Future research could address these limitations by expanding the sample size and employing more randomized sampling methods to improve the generalizability of the findings. Incorporating Confirmatory Factor Analysis (CFA) with a larger sample could validate and strengthen the Smart Beach Parameters framework developed through Exploratory Factor Analysis (EFA), ensuring its robustness across various contexts.

To mitigate sampling biases, researchers should consider mixed-methods approaches that combine quantitative surveys with qualitative interviews and observational data. This would offer a more comprehensive understanding of tourist experiences. Additionally, exploring different beach destinations, both within and beyond India, could provide insights into the framework's applicability in various settings.

Longitudinal studies could examine the long-term impact of smart tourism initiatives on tourist satisfaction and beach management, providing insights into the sustainability and effectiveness of these interventions. Research could also investigate the integration of emerging technologies, such as AI, AR, and VR, into the Smart Beach Parameters framework to enhance tourist experiences.

Lastly, future studies should explore the relationship between smart tourism initiatives and sustainable tourism practices. Understanding how smart technologies contribute to sustainability goals, such as reducing environmental impact and promoting responsible tourism, will offer valuable insights for developing effective beach tourism strategies. Addressing these aspects will advance the field of smart beach management and improve tourist experiences and destination attractiveness.

Conclusion

Tourism has been one of the first sectors to undergo digital transformation on a global scale, driven by the widespread adoption of information and communication technologies (ICT). This evolution emphasizes the importance of competitiveness, growth, and sustainable development within the industry. The introduction of the Smart Beach concept is a forward-thinking initiative that promises to enhance tourist experiences by providing high-tech services and integrating environmentally sustainable features.

As the tourism sector continues to evolve, the implementation of Smart Beaches in Goa could serve as a pioneering model, offering an innovative blend of technology and sustainability. This initiative would position Goa as a leader in smart tourism, appealing to both domestic and international markets. The concept aligns with the work of Buhalis and Amaranggana (2013), who emphasize the need for dynamically interconnected platforms that allow for the instantaneous exchange of tourism-related information. Such a system, accessible via multiple devices, would not only enhance the tourism experience but also optimize resource management, improving safety, sustainability, and competitiveness over time.

Given the significant decline in foreign tourist arrivals (FTA) post-COVID-19, Goa's adoption of Smart Beaches is both timely and strategic. It offers a path to revitalizing tourism, attracting a diverse range of visitors, and ensuring resilience against future disruptions. By leveraging real-time information systems, mobile applications, and smart infrastructure, Goa's beaches could address pressing issues such as safety, environmental concerns, and overcrowding—critical factors for maintaining long-term success. Studies by Sigalat-Signes et al. (2020) and Girau et al. (2018) highlight the value of using smart technologies for crowd management and information dissemination to enhance the tourist experience.

Moreover, the Smart Beach concept promises far-reaching benefits for Goa's tourism industry. By integrating cutting-edge technology into beach tourism, the region can offer a more engaging and secure experience, improving both tourist satisfaction and beach management. The initiative would mark Goa's debut in smart tourism, setting a precedent for other destinations to follow.

Smart Beaches present a holistic approach to tourism management, addressing both current challenges and future needs. Goa's beaches, which form an iconic part of its cultural and tourism landscape, stand to gain immensely from this transformation. By embracing smart technologies, Goa can ensure that its beach destinations remain competitive, sustainable, and attractive to tourists year-round, driving growth and long-term prosperity in the tourism sector.

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