Enhancing Sustainable Tourism Management in Thailand through Blockchain: Future Research Directions and Strategic Recommendations

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Abstract

The COVID-19 crisis has posed significant challenges to the sustainability of the tourism sector, particularly affecting policy makers in various countries. This crisis has had cascading effects on the related business sectors, with Thailand's tourism industry heavily reliant on the purchasing power of international tourists. The sudden absence of this foreign demand has resulted in a liquidity shortfall, leading many businesses within the sector to bankruptcy. This situation raises crucial questions about strategies for financial recovery: How can the financial status of the tourism sector be restored to its former state? A consensus among nations suggests that sustainability can be achieved by boosting domestic tourism consumption. Although the solution is recognized, Thailand continues to face challenges in stimulating domestic tourism demand. Previous research on innovations suggests that policy makers should support the integration of smart tourism concepts and blockchain technology to help revitalize the sector sustainably. This article proposes the use of blockchain as part of smart tourism initiatives for sustainable tourism development and highlights potential directions for future research.

1 Introduction

This conceptual paper aims to explore potential innovations that could serve as strategic interventions for fostering sustainable tourism development. It specifically scrutinizes innovations anticipated to elevate the self-reliance and sustainability of Thailand's tourism industry over the long term, focusing on their practical applicability. Among these, blockchain technology stands out as a promising tool for promoting smart tourism innovations.

Over the past decade, tourism has been recognized globally as a crucial economic driver, including in Thailand, where it significantly boosts foreign visitor inflow. However, the industry has overlooked negative externalities such as climate change, air pollution, excessive energy consumption, and natural resource degradation, as well as overtourism, which have become increasingly evident (S. Kim & Kim, 2020; Milano et al., 2018). Historically, economic models in tourism have failed to account for external costs (Van den Bergh, 2010), often resulting in prices that do not reflect true costs, hence contributing to faster-than-usual resource depletion.

Given the visibility and influence of tourism, the United Nations World Tourism Organization (UNWTO) and tourism stakeholders recognize these challenges and supports addressing them through its advocacy for the Sustainable Development Goals (SDGs) (Fakfare, Manosuthi, Lee, Promsivapallop, et al., 2024; Fakfare & Wattanacharoensil, 2024; Tham & Sigala, 2020). This global recognition has prompted countries, including Thailand, to adopt these goals as benchmarks for sustainable management achievements. In response to the ongoing COVID-19 crisis, various countries are reconsidering their strategies to include concepts such as smart cities, smart tourism, and smart tourism destinations (Lee et al., 2020; Tham & Sigala, 2020; Treiblmaier et al., 2021). Even Thailand's Tourism Authority of Thailand (TAT) has campaigned to transition from traditional tourism practices to ones that prioritize sustainability, successfully promoting Bangkok as a top global tourist destination for four consecutive years. Yet, the underlying issues of sustainability and environmental externalities remain largely unaddressed.

This problem is not unique to Bangkok but is also prevalent in tourist cities worldwide. Recent research anticipates and presents future innovations like blockchain for effectively managing these issues (Nam et al., 2021). For instance, Tham and Sigala (2020) expanded the application of blockchain to include digital assets, supporting more inclusive and sustainable development. Furthermore, the willingness of tourism operators in Taiwan to adopt new technologies for sustainable progress was explored by Treiblmaier et al. (2021). This growing awareness is not confined to academia but is also gaining traction in the business sector. For example, platforms like openvino.org utilize blockchain to enhance wine tourism by attracting tourists to natural vineyard environments. However, the integration of blockchain as a future innovation for sustainable tourism development remains underexplored in Thailand. This paper is designed to address this gap, aiming to provide a tangible framework for applying blockchain innovations to achieve the SDGs within the context of sustainable

tourism management. In conclusion, this paper will discuss academic research directions for further integrating innovative forecasting and sustainable tourism practices, an area still vastly under-researched within the Thai context.

2 Sustainable Development Goals and Tourism Management

Since their inception in 2015, the Sustainable Development Goals (SDGs) have set forth an ambitious agenda to address global challenges through 17 specific targets. The SDGs encompass a wide array of objectives, including environmental sustainability, poverty alleviation, and economic development, all of which are pertinent to the tourism sector. For instance, SDG 13 (Climate Action) directly impacts tourism through its focus on mitigating climate change effects, which can influence tourism patterns and destinations. Similarly, SDG 8 (Decent Work and Economic Growth) is vital for the tourism industry, which is a significant employment generator worldwide. Moreover, tourism has the potential to contribute positively to several other SDGs such as promoting sustainable cities and communities (SDG 11), responsible consumption and production (SDG 12), and life below water (SDG 14), through sustainable tourism practices that minimize environmental footprints and enhance cultural heritage preservation. To effectively integrate the principles of the SDGs into tourism management, stakeholders across the industry—including policymakers, business owners, and tourists—must commit to sustainable practices. This integration not only fosters economic growth and development but also ensures the long-term viability of tourism destinations in the face of environmental and social challenges. This section aims to highlight the critical intersection between the tourism industry and the SDGs, underscoring the need for a collaborative approach to sustainable tourism management that aligns with these global objectives. The tourism industry is intrinsically linked to each of these goals, both directly and indirectly, as illustrated in Table 1.

3 Smart Concepts in Sustainable Tourism

Current innovations in sustainable tourism management inevitably lead to discussions of 'smart' concepts, including smart cities, smart tourism, smart tourism cities, and smart tourism destinations. These concepts are widely used, often leading to confusion due to their overlapping aspects (Khan et al., 2017; Lee et al., 2020; Nuryyev et al., 2020). This paper aims to clarify these concepts through a synthesized definition drawn from contemporary research, simplifying their understanding and application.

SDGs	Title	Relevance to Tourism Context
1	Eradicating Poverty	Tourism generates income and employment both at community and local levels. Tourism acts as a catalyst for economic development at both community and local levels by generating substantial income and creating diverse employment opportunities. This sector not only supports local businesses but also stimulates growth in related industries such as retail and transportation.
2	Ending Hunger	Tourism can promote sustainable agriculture; hotels and restaurants can utilize these agricultural products as ingredients for preparing food for tourists, while local farmers can also retain some produce for their own consumption.
3	Good Health and Well-being	At the macro level, health and well-being goals stem from government policy allocations. Tourism generates community income and the taxes paid to the government from the industry's expansion can help achieve these goals. Additionally, wellness tourism can also address these objectives at the micro level.
4	Quality Education	Tourism and education mutually benefit each other; as tourism grows, the development of high-quality research increases. Similarly, a robust educational system enhances the skills and capabilities of professionals within the industry.
5	Gender Equality	Women are closely associated with the service sector, and the tourism industry often faces a shortage of qualified frontline staff. Positions in this industry emphasize interpersonal interactions and service, roles in which women in Thailand excel. Therefore, the tourism industry provides women with greater opportunities for involvement and advancement compared to other sectors, such as pre-construction supervision.
6-7	Clean Water and Sanitation (6) and Affordable and Clean Energy (7)	Traditionally, the tourism industry has been viewed as a significant polluter. However, modern perspectives increasingly focus on addressing externalities, with environmental economics being incorporated into economic studies to highlight the issues of overlooked externalities. Thus, sustainable tourism promotes the reduction of environmental pollution.
8	Decent Work and Economic Growth	Investment in tourism infrastructure and innovation has focused increasingly on enhancing the tourist experience and improving efficiency. Innovations such as digital bookings and eco-friendly practices are transforming the landscape of travel and tourism.
9	Industry, Innovation, and Infrastructure	Tourism promotes investment in both infrastructure and innovation within the sector. Innovations over the past five years have primarily focused on service innovations in tourism.
10	Reduced Inequality	Local or community-driven tourism initiatives empower communities economically and socially by redistributing income from tourism and supporting local cultural preservation efforts, thereby reducing inequalities within and among communities.
11	Sustainable Cities and Communities	A new dimension in tourism innovation involves integrating smart tourism concepts with smart city developments to create smart tourism cities. Elevating a regular city to a smart tourism city would be a hallmark of sustainable urban success.
12-15	Responsible Consumption and Production (12),Climate Action (13), Life Below Water (14), and Life on Land (15)	Traditionally, the tourism industry has been perceived as lacking accountability due to its significant environmental impact. However, contemporary perspectives are increasingly focusing on externalities, and even economic curricula now include environmental economics to address these issues. Thus, sustainable tourism promotes increased accountability across the supply chain and reduces environmental pollution, both on land and in water.
16	Peaceful and Inclusive Societies	Experiential and cultural tourism promote understanding and positive experiential exchanges between tourists and communities. Similarly, volunteer tourism represents a type of tourism with the potential to generate benefits for communities beyond mere financial gains.
17	Partnerships for the Goals	Contemporary tourism management emphasizes collaboration among various stakeholders including government, private sector, academia, businesses, communities, and tourists, extending also to international levels. The shared goals of the SDGs are recognized globally, necessitating cooperation to achieve them by 2030. Given the interconnected nature of tourism with multiple sectors and the trend towards integration and sharing of information and knowledge globally, tourism plays a critical role in driving countries to meet their 2030 objectives.

Table 1: The Intersection of Tourism and Sustainable Development Goals

Smart City

The idea of a smart city varies in scope. From a policymaker's perspective, it often involves urban planning combined with the deployment of technology for efficient management (Lak et al., 2020). As cities expand, seamless urban architecture becomes crucial. For instance, Lat Krabang in Thailand was not considered a part of Bangkok in 1994 but is now seen as an extension of the city. This example highlights the integration of Internet of Things (IoT) technologies in designing smart cities (Simmhan et al., 2018). To distinguish the concept of a smart city from smart tourism, tourism studies often define a smart city in terms of innovative management practices rather than just architectural or infrastructural terms (Gretzel et al., 2015).

In the context of sustainable tourism, a smart city is a management approach that incorporates modern technology to create a greener metropolis, innovative commerce, and improved quality of life compared to traditional management practices (De Falco et al., 2019; Lee et al., 2020). Implementing these concepts is complex and requires time for full integration (Angelidou, 2017). Specifically, smart cities utilize data science to process data into information for urban management, providing a cost-effective long-term solution with greater precision and efficiency (Hashem et al., 2016). This includes processing both soft data (non-directly measurable data) and hard data (objectively measurable data), which in the past was nearly impossible to gather accurately due to technological limitations (Wataya & Shaw, 2019). For example, smart cities now leverage big data, such as website visitation patterns combined with social media engagement data like 'Like' and 'Share' buttons. These data points are stored in cloud systems and can be analyzed to deduce community preferences, significantly enhancing management accuracy (Mora et al., 2016). Cardullo and Kitchin (2019) illustrate this with the example of Dublin, Ireland, where citizen-centric information processing transforms raw data into actionable insights.

Furthermore, smart systems not only store individual-generated data but also capture non-personal data impacting city dwellers, such as infrastructure metrics. It's unsurprising that many research studies measure smart city attributes through both hard and soft data dimensions. Neirotti et al. (2014) propose measuring smart city levels across eight dimensions including mobility, buildings, healthcare, entertainment, education, public safety, environment, and economy. Zhang et al. (2017) further distill these into four key components: environment, energy, industry, and services and living. Lee et al. (2020) simplify these measurements into three main dimensions: service, infrastructure, and environmental resources, making it easier to assess and apply the smart city components effectively. By clarifying and synthesizing these concepts, this paper contributes to a more nuanced understanding and application of smart principles in the management of sustainable tourism, aiming to bridge the gap between theoretical frameworks and practical implementation.

Smart Tourism

Similar to the concept of smart cities, smart tourism leverages both soft and hard data to process and transform into actionable information. The primary objective of smart tourism is to enhance the efficiency of business operations while simultaneously elevating the tourist experience and adding sustainable value to the entire tourism industry value chain. In practice, smart tourism is structured around three phases of a tourist's journey: the pre-travel phase, the traveling phase, and the post-travel phase (Buonincontri & Micera, 2016). Contemporary efforts in data collection now occur in real-time, transforming real-time data directly into real-time information (Gretzel et al., 2015). Therefore, smart tourism manifests in ways that benefit both tourists (e.g., personalizing or managing their travel experiences independently) and service providers (e.g., using information to enhance tourist satisfaction). Recent research indicates that the concept of smart tourism is a key factor influencing tourists' destination choices, especially among Free Individual Travelers (FITs), who are increasingly numerous and tend to rely on smart systems for decision-making. From the perspective of service providers, studies have shown that after implementing smart tourism systems, hospitality businesses have seen increased profits due to their ability to offer more personalized and precisely targeted services to customers (J.-Y. Kim et al., 2016).
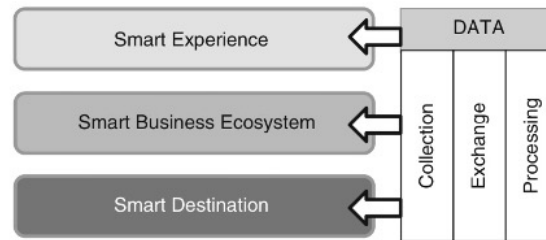

Figure 1: Components of Smart Tourism according to Gretzel et al. (2015)

This model shown in Figure 1 not only contributes to a more satisfying and efficient travel experience but also supports sustainable practices within the industry by ensuring that resources are used more effectively and that the interactions between tourists and destinations are managed with greater awareness and care. By integrating technology and data analytics, smart tourism offers profound benefits, enhancing both the economic and experiential aspects of tourism. Similar to the concept of smart cities, smart tourism utilizes data—both soft and hard—to convert into actionable information with the primary aim of enhancing the efficiency of business operations and enriching the travel experience. This approach not only improves tourist satisfaction but also adds sustainable value to the entire tourism industry's value chain. Gretzel et al. (2015) have identified three fundamental components of smart tourism: Smart Destination, Smart Experience, and Smart Business. These elements underscore the inte-

gration of technology at various stages of the tourist experience, as depicted in Figure 1. The conceptual framework laid out by Gretzel et al. (2015) categorizes the data handling process in smart tourism into three levels: the initial level involves Data Collection facilitated by a Smart Exchange system. The second level focuses on Smart Processing—analyzing and processing the data to extract valuable information. The outcomes from this level are then integrated with the traditional five main components of a tourist destination (the 5As) as expanded by Lee et al. (2020), which include Transportation, Gastronomy, Attractions, Ancillary Services, and Accommodation. An interesting application of smart tourism in the business world can be observed during the COVID-19 pandemic, which significantly impacted global tourism. For instance, Venice introduced innovative tourism products that catered to the home quarantine conditions of people worldwide. These products leveraged Augmented Reality (AR) and Virtual Reality (VR) technologies to simulate real tourist destinations, allowing tourists to experience these places from their homes. Similarly, Thailand developed the SEE THROU application, which uses the same concepts of AR and VR as Venice. However, the accessibility and promotional efforts for this application have not yet reached a broad audience or effectively targeted potential users. This example highlights the resilience and adaptability of the tourism industry through the integration of smart tourism concepts, which not only help in sustaining tourism during challenging times but also pave the way for innovative future engagements that could redefine traditional tourism practices.

Smart Tourism Cities and Destinations

Historically, questions have been raised about whether the application of smart city concepts to tourism management could enhance the ingenuity of tourist experiences. Specifically, could transforming an ordinary city into a smart tourism city offer tourists a more novel and enhanced experience than ever before? Researchers have delved into these inquiries, and a key finding from past studies indicates a strong correlation between the quality of tourist experiences and the quality of life for residents within these destinations. Research has shown that cities managed under smart city principles tend to leave a more favorable impression on tourists compared to those governed by traditional methods (Boes et al., 2016). Consequently, the concept of the smart tourism city has emerged through the integration of smart tourism initiatives within the broader smart city framework. However, the terminology used in the field differentiates between 'smart tourism cities' and 'smart tourism destinations' based on the focus of the application. Researchers use 'smart tourism city' when the focus is on enhancing the living conditions and experiences of the city's residents, ensuring that the infrastructure and services improve their quality of life. In contrast, 'smart tourism destination' is used when the primary goal is to enrich the tourist experience, creating positive and memorable interactions for visitors (Neuhofer et al., 2012).

This distinction is crucial because it highlights the dual objectives of smart tourism applications: improving the socio-economic conditions for residents and

simultaneously enhancing the visitor experience. Smart tourism cities and destinations leverage technology, such as data analytics, the Internet of Things (IoT), and digital platforms, to optimize city functions and tourist services. This approach not only aids in traffic management and energy efficiency but also enhances cultural offerings and local attractions, directly benefiting tourists and residents alike. Through these innovations, smart tourism cities and destinations are setting new standards for how tourism can symbiotically benefit both visitors and local communities, promoting sustainable urban development and creating a more interactive and responsive environment for all stakeholders involved.

4   Application of Blockchain Innovation in Tourism Management

Blockchain technology represents a paradigm shift in digital record-keeping where all transactions are transparently displayed in chronological order, a feature that enhances stakeholder confidence (Janssen et al., 2020). Each transaction is recorded in 'blocks' which, as transactions continuously occur, connect to form a permanent chain, hence the term 'blockchain' (Tham & Sigala, 2020). This transparency makes blockchain an ideal technology for verifying crucial transactions, particularly in the financial sector (Tapscott & Tapscott, 2017). Furthermore, blockchain facilitates the creation of digital assets, such as cryptocurrencies.

One of the intriguing applications of blockchain in tourism is its use in the wine tourism industry. In 2018, the Openvino project utilized blockchain to enhance business operations by digitally recording every significant activity and transaction within the company—from vine planting and harvesting to wine production and financial accounting. This comprehensive recording allows stakeholders unrestricted access to verify the activities independently, making the tourism experience particularly appealing to those who value transparency. Moreover, the project issued a digital asset, MBT18, in 2018, which purchasers could exchange for wine in 2021. The price of the token at the time of sale was equivalent to the price of the wine once bottled in 2021. Token holders had the option to trade these on the exchange if the market value rose above the purchase price, creating liquidity and debt-free operations compared to traditional bank loans, aligning with SDGs 8, 9, and 12. This approach also mitigates financial disparities as small businesses, which typically struggle to secure bank loans, can leverage blockchain to access funding, thereby promoting financial inclusion and sustainable community development (SDGs 10 and 11).

In Thailand, if a farmer owns land and wants to start an organic agricultural tourism business, they can use blockchain and digital assets to facilitate their operations. If these farmers lack construction expertise, they can also securely vet and select contractors through blockchain transactions (aligned with SDG 17). Additionally, the government can monitor greenhouse gas production and natural resource degradation through blockchain, enhancing the accuracy of car-

SDGs	Impact of Blockchain Innovation on Promoting Smart Tourism
7	Indirect impact
8	Direct impact
9	Direct impact
10	Direct impact
11	Direct impact
12	Indirect impact
17	Direct impact

Table 2: Impact of Using Blockchain on Smart Tourism to Support SDGs

bon credit trading and environmental management (aligned with SDGs 11-13). Table 2 summarizes how blockchain innovation supports the achievement of the Sustainable Development Goals by enhancing the efficiency and transparency of smart tourism concepts. This integration not only boosts tourism's contribution to economic and social development but also ensures environmental sustainability through improved resource management.

5   Conclusion and Future Research Directions

Numerous countries have integrated the concept of smart tourism with the development of smart cities to enhance memorable and positive tourist experiences. Previous research has highlighted that such innovative approaches significantly contribute to sustainability, which is a critical goal for national development (Fakfare, Manosuthi, Lee, Han, et al., 2024; Fakfare, Manosuthi, Lee, Lee, & Han, 2024; Fakfare, Manosuthi, Lee, Promsivapallop, et al., 2024; Fakfare & Wattanacharoensil, 2024; Manosuthi, Lee, & Han, 2024; Manosuthi, Meeprom, & Leruksa, 2024). One of the notable advantages of smart concepts is the transformation of data into information, which not only allows businesses to offer more precisely tailored services that meet the increasingly complex demands of modern tourists but also enhances resource management efficiency. As a result, the degradation of natural resources is minimized, extending the lifespan of tourist destinations (Van den Bergh, 2010).

Sustainability metrics, commonly measured through the 17 Sustainable Development Goals (SDGs), suggest that current smart tourism innovations can potentially achieve all 17 goals (Gössling & Michael Hall, 2019). This conceptual paper further illustrates with hypothetical examples based on real-world cases, demonstrating clearly how future innovations such as blockchain can increase transparency. Additionally, these innovations can expedite the achievement of specific SDGs, particularly goals 8-12 and 17, by enhancing the efficiency of smart tourism concepts (as detailed in the sections on applying future innovations in tourism management and summarized in Table 2).

Beyond practical implications, this paper concludes by proposing academic research topics that could develop strategies for sustainable tourism. It aims

to be of substantial value to the academic community, suggesting potential research areas that could be explored further. These topics might include assessing the long-term impacts of smart tourism on local economies, the effectiveness of blockchain in protecting environmental and cultural heritage, or strategies to enhance stakeholder engagement in planning and implementing smart tourism initiatives. This synthesis aims to inspire future studies that not only address practical challenges but also contribute to the theoretical underpinnings of sustainable tourism development.

Domestic Tourism Awareness through Technology

Historically, Thailand has heavily relied on international tourists, as illustrated by Phuket's situation in 2014, where despite a local population of 378,364, the region welcomed over 10 million foreign tourists (Chavarria & Phakdee-Auksorn, 2017). The COVID-19 pandemic starkly reduced the influx of international tourists, revealing a significant reluctance among domestic tourists to visit higher-priced destinations like Phuket. This over-reliance on international tourists has highlighted the lack of sustainability in such tourism models, underscoring the need for a robust domestic tourism sector as a resilient buffer for Thailand's tourism industry. International research has investigated ways to stimulate domestic tourism awareness, frequently employing the Theory of Planned Behavior (TPB), which suggests that subjective norms significantly influence travel intentions and engagement (Kamble et al., 2019; Manosuthi et al., 2020, 2021a). While these studies are prevalent internationally, there is a noticeable gap in similar research within Thailand. The insights from these studies are invaluable for fostering domestic tourism and consumption, which are foundational to sustainable development.

This paper advocates for further research to explore effective strategies to cultivate a culture of domestic travel among Thai tourists, particularly through the innovative use of technology. The potential for technology to support the creation of enduring values and behaviors that promote sustainable tourism practices is immense. Researchers are encouraged to investigate how technological tools can be harnessed to reinforce domestic tourism values sustainably. This might involve developing apps that highlight local attractions, using social media campaigns to shift public perceptions, or creating interactive platforms that engage local tourists with personalized travel suggestions based on their preferences and behaviors. Such research could significantly contribute to shaping a more resilient and sustainable tourism landscape in Thailand.

Testing Causal Relationships, Especially the Influence of Smart Urbanization, Smart Tourism, and Blockchain as Pull Motivation Factors

In recent times, many countries have successfully integrated the concept of smart tourism with the development of smart cities to cultivate a memorable and positive tourism experience. Past research has indicated that such innovative

strategies are critical in promoting sustainability, which is essential for national development (Fakfare, Jianvittayakit, & Wattanacharoensil, 2024; Fakfare & Lee, 2019; Fakfare, Lee, & Ryu, 2020; Hosany et al., 2022). Furthermore, converting data into actionable information through smart technologies not only meets the complex demands of modern tourists but also significantly enhances resource management efficiency. This can lead to reduced degradation of natural resources and prolong the viability of tourist destinations (Van den Bergh, 2010).

A particularly interesting point of inquiry is examining smart tourism and smart urbanization as sources of pull motivation. Research to date suggests that policies such as tax incentives have a significant influence on decisions to visit less popular tourist destinations Fakfare, Talawanich, and Wattanacharoensil, 2020. This subject deserves further exploration, especially regarding how tourism innovations serve as a key motivator in destination choice. Additionally, the intersection of smart tourism and blockchain technology presents another rich area for extending research on location attractiveness factors, specifically exploring and testing the causal relationships associated with memorable tourist experiences, whether positive or negative. The implications of such research are profound for the Thai tourism industry as policymakers could use these insights to formulate more precise strategies to promote domestic tourism. Further exploration is encouraged on how to create and sustain values that encourage Thai tourists to travel domestically, particularly with the support of technology to foster sustainable practices.

Another noteworthy aspect involves the use of Structural Equation Modeling (SEM) analysis. The analytical technique of SEM has been primarily used to calculate the influence of variables and understand the direction and magnitude of relationships that researchers are interested in. Recent developments in SEM introduce more detailed and flexible methodologies like composite-based analysis (e.g., PLSc or IGSCA), which are becoming increasingly popular in social sciences and business administration due to their lower bias compared to traditional factor-based SEM (ML: factor-based SEM, PLS, and GSCA: composite-based SEM). These new methods are particularly useful when researchers incorporate variables that blend both factor and composite types (Fakfare et al., 2021). Researchers interested in exploring motivational aspects in social sciences are invited to investigate these innovative analytical techniques, which provide a nuanced approach to understanding complex social phenomena. Detailed guidelines on these new analytical methods have been outlined by Manosuthi et al. (2021b), providing a valuable resource for scholars aiming to employ these advanced statistical tools in their research.

Managing Externalities through Blockchain Innovation and Smart Tourism

Over the past decade, tourism has been recognized as a crucial engine for stimulating global economies, including Thailand. The influx of international tourists into various countries has highlighted the significant, often overlooked negative externalities such as climate change, air pollution, high energy consumption,

and the degradation of natural resources. Overtourism, in particular, has become more visible and problematic for communities and tourist destinations (Fakfare et al., 2022; S. Kim & Kim, 2020; Koh & Fakfare, 2020; Milano et al., 2018). One reason for these adverse impacts is that traditional economic perspectives did not account for the costs associated with externalities (Van den Bergh, 2010). As a result, the pricing of goods and services within the tourism industry has been historically underestimated, focusing only on direct accounting costs. Consequently, the real cost of resource degradation, often exceeding the tourism value of the destination itself, was not reflected, leading to faster than normal resource depletion.

This scenario underscores the urgent need to integrate sustainability into every facet of tourism management. The application of blockchain technology and smart tourism initiatives presents a transformative opportunity to manage these externalities effectively. Blockchain can enhance transparency and accountability by securely recording and verifying every transaction related to tourism activities. This can include tracking the energy consumption of hotels or the waste management practices of tourist attractions, thereby allowing more accurate reflection and pricing of environmental costs. Moreover, smart tourism, leveraging data analytics and IoT (Internet of Things) technologies, can optimize resource use and reduce waste through smarter allocation and consumption patterns. These technologies provide a real-time response to tourist behavior and resource status, facilitating a dynamic adjustment to minimize negative impacts.

The integration of blockchain and smart tourism not only elevates a country's image by showcasing commitment to sustainable practices but also ensures that the economic benefits of tourism do not come at the expense of the environment. For instance, blockchain could be used to create a more sustainable supply chain for tourism-related products by ensuring that all stakeholders comply with environmental standards. Similarly, smart tourism could allow destinations to predict peak periods and manage tourist flows to minimize environmental strain. In conclusion, adopting these innovative technologies to manage externalities is not merely an enhancement to the tourism sector but a necessary evolution towards sustainable tourism management. This approach should be at the forefront of policy-making and strategic planning in the tourism industry, ensuring that sustainability is not just a concept, but a practical reality integrated into the daily operations and long-term planning of tourist destinations.

6 Acknowledgement

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