



Big Data Analytics and Blockchain for Personalized Ecotourism: Toward a Digital Governance Framework for Sustainable Destinations

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ABSTRACT

Submitted: 28-05-2026 **Purpose of the study** — This study develops a conceptual framework explaining how Big Data Analytics and blockchain-enabled trust governance can support personalized ecotourism and sustainable destination management.

Accepted: 07-06-2026 **Research Methodology**— This study applies an integrative conceptual review. Literature was collected from Scopus, Web of Science, ScienceDirect,

Published: 06-07-2026 SpringerLink, Taylor & Francis Online, Emerald Insight, SAGE Journals, and Google Scholar for DOI verification. The review used keyword-based searching, inclusion and exclusion criteria, concept-centric coding, thematic synthesis, and conceptual proposition development. No survey instrument, statistical software, or empirical dataset was used.

Result— The synthesis identifies four main constructs: Big Data Analytics Capability, Blockchain-Enabled Trust Governance, Personalized Ecotourism Experience, and Sustainable Destination Management. The framework shows that Big Data Analytics functions as an intelligence capability for visitor insight, prediction, monitoring, and decision support. Blockchain strengthens trust, transparency, consent, traceability, and stakeholder accountability. Personalized Ecotourism Experience serves as a linking mechanism between digital capability and sustainability-oriented destination outcomes.

Conclusion— This study proposes Digital Ecotourism Governance Capability as an integrative concept combining analytical intelligence, trusted coordination, ethical data governance, visitor impact control, and community value creation. The framework contributes to tourism management, smart tourism, ecotourism, sustainable destination management, and digital governance literature.

Limitations: This study is conceptual and literature-based; therefore, the proposed framework and propositions require empirical validation in real ecotourism destinations.

Contribution: The study provides a theoretical basis for future empirical research and a managerial guide for destinations seeking to personalize visitor experiences while protecting ecological limits and community interests.

Keywords : *Big Data Analytics; Blockchain; Personalized Ecotourism; Sustainable Destination Management; Digital Governance.*



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INTRODUCTION

Sustainable destination management has moved from a conservation-oriented agenda to an evidence-based managerial agenda because destinations must balance tourist experience, local economic value, environmental protection, and stakeholder legitimacy (Rahmadian et al., 2022; Shafiee et al., 2019). Ecotourism intensifies this managerial challenge because nature-based destinations depend on ecological quality, visitor behavior control, environmental interpretation, and the ability of managers to prevent tourism pressure from exceeding acceptable social and environmental limits (Northcote, 2020; Poudel & Nyaupane, 2013). Visitor management in ecotourism therefore requires more than promotion and access provision, because destination managers must understand visitor preferences, spatial movement, environmental sensitivity, carrying capacity, and community interests at the same time (Northcote, 2020; Shams et al., 2022).

The growth of digital traces from social media, mobile devices, online reviews, booking systems, sensors, and location-based services has created new opportunities for tourism destinations to read visitor behavior with greater precision (Del Vecchio et al., 2018; Rahmadian et al., 2022). Big Data Analytics enables tourism managers to identify demand patterns, segment visitors, predict behavior, support decision-making, and design more relevant tourism experiences (Agrawal et al., 2022; Rahmadian et al., 2022). In smart tourism destinations, social big data can strengthen personalization, innovation, stakeholder networking, and destination value creation when the data are transformed into managerial knowledge rather than treated as passive digital records (Del Vecchio et al., 2018; Shafiee et al., 2019).

Personalized ecotourism becomes important because tourists increasingly expect recommendations, routes, interpretation, and services that fit their interests, mobility conditions, environmental values, and travel constraints (Alshamlan et al., 2023; Zhang et al., 2025). Personalization in ecotourism should not only increase satisfaction, because poorly governed personalization can intensify visitor concentration, commercialize fragile ecosystems, and weaken conservation objectives (Northcote, 2020; Rahmadian et al., 2022). A sustainable personalization logic must therefore connect visitor preferences with ecological limits, local community priorities, and destination-level impact monitoring (Northcote, 2020; Shams et al., 2022).



Blockchain offers a complementary governance layer for digital tourism because it can support transparency, traceability, digital identity, smart contracts, data integrity, and trusted transactions among fragmented tourism actors (Balasubramanian et al., 2022; Kizildag et al., 2020). Tourism and hospitality studies suggest that blockchain should be assessed from its managerial value for consumers and suppliers, rather than merely from its technological novelty (Önder & Gunter, 2022; Treiblmaier, 2022). Blockchain can also strengthen tourist control over personal data, reduce trust problems in digital transactions, and support permissioned data sharing for personalized services (Balasubramanian et al., 2022; Line et al., 2020).

The practical problem is that many destination management systems still rely on fragmented data flows, weak stakeholder coordination, limited real-time monitoring, and insufficient governance of visitor data (Balasubramanian et al., 2022; Rahmadian et al., 2023). Big data can improve sustainable tourism decisions, but its use remains constrained by data quality, privacy concerns, governance capacity, and the gap between analytical insight and destination-level action (Line et al., 2020; Rahmadian et al., 2023). Blockchain can address several trust and traceability issues, but tourism research still treats blockchain applications in a fragmented manner across booking, payment, identity, loyalty, reviews, and travel-stage services (Balasubramanian et al., 2022; González-Mendes et al., 2024).

The research gap lies in the limited integration between Big Data Analytics, blockchain-enabled trust mechanisms, personalized ecotourism experience, and sustainable destination management in one coherent conceptual framework (Agrawal et al., 2022; Balasubramanian et al., 2022; Rahmadian et al., 2022). Prior studies have examined big data for sustainable tourism, smart destination development, blockchain use cases, and visitor management, but fewer studies explain how these streams can jointly guide ecotourism personalization while protecting ecological and stakeholder interests (Del Vecchio et al., 2018; Northcote, 2020; Shafiee et al., 2019). This gap is theoretical because the relationship between data-driven personalization, decentralized trust, and sustainable destination governance remains underdeveloped in tourism management literature (Line et al., 2020; Shams et al., 2022).

The novelty of this study lies in the development of Digital Ecotourism Governance Capability as an integrative concept that connects analytical intelligence, decentralized trust, ethical data governance, visitor impact control, and community-oriented value creation. Unlike general smart tourism destination studies that primarily emphasize technological infrastructure and service innovation, this study focuses on the specific governance challenges of ecotourism destinations, where personalization must be aligned with ecological carrying capacity, conservation education, visitor dispersion, and local community benefit. This conceptual contribution is important because digital personalization in ecotourism cannot be evaluated

only through tourist satisfaction or service efficiency. It must also be assessed through its ability to protect fragile ecosystems, reduce visitor pressure, strengthen stakeholder accountability, and support long-term destination resilience.

This study addresses the gap by proposing a conceptual framework that integrates Big Data Analytics and blockchain for personalized ecotourism and sustainable destination management (Agrawal et al., 2022; Balasubramanian et al., 2022). The framework positions Big Data Analytics as an intelligence capability for understanding visitor preferences and destination conditions, while blockchain functions as a governance mechanism for trust, transparency, consent, traceability, and stakeholder accountability (Del Vecchio et al., 2018; Line et al., 2020). The proposed framework is important for tourism theory because it links smart tourism, sustainable tourism, data governance, and digital trust into a single conceptual logic for ecotourism destinations (Rahmadian et al., 2023; Shafiee et al., 2019). The framework is also relevant for practice because destination managers need tools that personalize visitor experience without sacrificing conservation, community value, and long-term destination resilience (Northcote, 2020; Poudel & Nyaupane, 2013).

LITERATURE REVIEW AND HYPOTHESIS / PROPOSITION DEVELOPMENT

A. LITERATURE REVIEW

Big Data Analytics Capability in Sustainable Tourism

Big Data Analytics Capability refers to the ability of tourism organizations to collect, integrate, analyze, and transform large-scale tourism data into managerial insight for decision-making, experience design, and destination governance (Agrawal et al., 2022; Rahmadian et al., 2022). Tourism data are increasingly generated through social media, online reviews, mobile applications, booking platforms, sensors, user-generated content, and location-based services, making destination management more dependent on data interpretation than on conventional market observation alone (Del Vecchio et al., 2018; Rahmadian et al., 2022). In sustainable tourism, Big Data Analytics is not merely a technical tool but a managerial capability because it supports demand forecasting, visitor segmentation, behavior prediction, resource allocation, and monitoring of environmental and social impacts (Agrawal et al., 2022; Shams et al., 2022).

The theoretical relevance of Big Data Analytics can be explained through the dynamic capability view because destinations must sense visitor demand, seize digital opportunities, and reconfigure tourism resources according to changing sustainability pressures (Horng et al., 2022; Shafiee et al., 2019). Social big data also strengthens smart tourism destinations by enabling personalized offerings, stakeholder collaboration, innovation, and more responsive destination strategies (Del Vecchio et al., 2018). However, the value of big data depends on governance quality because data abundance does not automatically produce sustainable



destination outcomes (Line et al., 2020; Rahmadian et al., 2023). Weak data governance can create privacy risks, fragmented decision-making, and unequal value distribution between tourists, platforms, firms, local communities, and destination managers (Line et al., 2020; Leal et al., 2021).

Blockchain-Enabled Trust and Data Governance

Blockchain refers to a distributed ledger technology that enables verified, traceable, transparent, and tamper-resistant records among multiple actors without relying entirely on a central intermediary (Balasubramanian et al., 2022; Önder & Gunter, 2022). In tourism and hospitality, blockchain has been discussed for digital identity, smart contracts, secure payment, loyalty programs, review authenticity, disintermediation, traceability, and trusted data exchange (Kizildag et al., 2020; Treiblmaier, 2022). Blockchain is therefore relevant not because it is a fashionable technology, but because tourism is a fragmented service system involving tourists, destination managers, local communities, accommodation providers, guides, intermediaries, regulators, and digital platforms (Balasubramanian et al., 2022; Önder & Gunter, 2022).

Blockchain-enabled governance can improve data control, consent, transparency, and trust in personalized tourism services (Balasubramanian et al., 2022; Line et al., 2020). This function is important for ecotourism because personalized services often require sensitive data on tourist preferences, mobility, location, spending behavior, and environmental interests (Leal et al., 2021; Yang et al., 2024). Blockchain can support accountability and traceability in data sharing, but it must be combined with clear off-chain governance, stakeholder rules, and ethical data practices to avoid technological determinism (Rahmadian et al., 2023; Treiblmaier, 2022).

Personalized Ecotourism Experience

Personalized Ecotourism Experience refers to the tailoring of routes, interpretation, recommendations, services, and visitor engagement based on tourist preferences, ecological sensitivity, destination capacity, and local sustainability priorities (Northcote, 2020; Yang et al., 2024). Personalized tourism recommendations can improve user experience when tourists perceive the information as relevant, high quality, and aligned with their needs (Yang et al., 2024). In ecotourism, personalization should also guide visitors toward low-impact behavior, appropriate spatial distribution, conservation learning, and responsible consumption (Northcote, 2020; Poudel & Nyaupane, 2013).

Ecotourism differs from ordinary leisure travel because the experience depends on the quality of nature, interpretation, conservation behavior, and the relationship between visitors and host communities (Poudel & Nyaupane, 2013). Visitor management frameworks show that



sustainable destinations must monitor whether specific sites approach or exceed acceptable environmental, cultural, and social thresholds (Northcote, 2020). Therefore, personalization in ecotourism should not only maximize tourist satisfaction, but should also support visitor dispersion, conservation interpretation, community benefit, and ecological carrying capacity (Northcote, 2020; Shams et al., 2022).

Sustainable Destination Management

Sustainable Destination Management refers to the coordination of destination resources, stakeholders, technologies, visitor flows, and environmental safeguards to achieve economic, social, cultural, and ecological balance (Shafiee et al., 2019; Shams et al., 2022). Smart tourism destination literature argues that sustainability and digital technology must be integrated because destination competitiveness increasingly depends on the ability to manage data, stakeholder interaction, and visitor experience simultaneously (Shafiee et al., 2019). Sustainable tourism also requires stakeholder participation because tourism impacts are distributed across residents, firms, tourists, public institutions, and ecological systems (Shams et al., 2022).

Big Data Analytics and blockchain can support Sustainable Destination Management through different but complementary mechanisms (Agrawal et al., 2022; Balasubramanian et al., 2022). Big Data Analytics provides intelligence for prediction, segmentation, monitoring, and personalization, while blockchain provides trust, traceability, consent management, and verifiable coordination among stakeholders (Balasubramanian et al., 2022; Rahmadian et al., 2023). The integration of both technologies can create a stronger digital governance architecture for ecotourism because data-driven insight must be accompanied by transparent and accountable data exchange (Leal et al., 2021; Line et al., 2020).

Digital Ecotourism Governance Capability as an Integrative Concept

Digital Ecotourism Governance Capability refers to the ability of an ecotourism destination to integrate data-driven intelligence, trusted digital coordination, ethical data governance, visitor impact control, and community value creation in managing personalized tourism experiences. This capability is not limited to the adoption of digital tools. It represents a higher-order governance capacity that enables destinations to use technology responsibly while maintaining ecological, social, and institutional balance.

The concept consists of five main dimensions. First, analytical intelligence refers to the ability to collect, integrate, analyze, and transform multi-source tourism data into actionable insight for visitor management and sustainability decisions. Second, trusted coordination refers to the use of blockchain-enabled mechanisms to support transparency, traceability, consent, digital identity, and accountable transactions among tourism stakeholders. Third, ethical data



governance refers to accountability, responsibility, and transparency in collecting, processing, sharing, and using tourist and destination data. Fourth, visitor impact control refers to the ability to manage visitor flows, reduce pressure on fragile sites, support low-impact behavior, and align personalized recommendations with ecological carrying capacity. Fifth, community value creation refers to the capacity of digital ecotourism systems to support local participation, fair benefit distribution, authentic local services, and community-based conservation.

This concept differs from the general idea of smart tourism destination because it places stronger emphasis on ecological protection, responsible visitor management, and stakeholder accountability in nature-based destinations. Smart tourism destination literature often highlights technology-enabled experience, competitiveness, and data-driven innovation. In contrast, Digital Ecotourism Governance Capability emphasizes that personalization must be governed by sustainability principles, conservation priorities, and community interests. Therefore, it provides a more specific theoretical lens for understanding how Big Data Analytics and blockchain can jointly support sustainable ecotourism destination management.

Table 1. Key Constructs and Dimensions

Construct	Conceptual Definition	Main Dimensions
Big Analytics Capability	The capability of an ecotourism destination Data to collect, integrate, analyze, and transform multi-source tourism data into actionable insight for visitor experience design and sustainability-oriented decision-making.	Data collection, data integration, predictive analytics, real-time monitoring, decision support.
Blockchain-Enabled Trust Governance	The use of blockchain-based mechanisms to improve trust, traceability, transparency, consent, data integrity, and secure stakeholder coordination in digital tourism systems.	Data integrity, consent control, smart contracts, digital identity, traceability, review authenticity.
Personalized Ecotourism Experience	Tailored ecotourism services, routes, interpretation, and recommendations that align tourist preferences with ecological limits and local sustainability priorities.	Context-aware recommendation, environmental interpretation, visitor routing, low-impact behavior guidance, local value orientation.
Sustainable Destination Management	The coordinated governance of destination resources, visitor flows, stakeholder interests, and conservation objectives to achieve ecological, social, cultural, and economic balance.	Ecological protection, visitor impact control, stakeholder collaboration, community benefit, adaptive destination decision-making.



Construct	Conceptual Definition	Main Dimensions
Digital Ecotourism Governance Capability	An integrative governance capability that combines analytical intelligence, trusted coordination, ethical data governance, visitor impact control, and community value creation in personalized ecotourism systems.	Analytical intelligence, trusted coordination, ART data governance, visitor impact control, community value creation.

B. CONCEPTUAL PROPOSITION DEVELOPMENT

Big Data Analytics Capability can strengthen Personalized Ecotourism Experience because it enables destination managers to identify visitor preferences, mobility flows, behavioral patterns, environmental interests, and service needs from multiple digital data sources. When these data are transformed into actionable insight, destinations can design context-aware recommendations, adaptive visitor routes, personalized interpretation content, and more relevant visitor services. In ecotourism, such personalization should not only follow tourist preferences, but also consider ecological limits, conservation rules, and local community priorities.

Proposition 1: *Big Data Analytics Capability enhances Personalized Ecotourism Experience by transforming multi-source tourism data into context-aware recommendations, visitor routing, and tailored environmental interpretation.*

Big Data Analytics Capability can also strengthen Sustainable Destination Management because historical and real-time data support visitor monitoring, demand forecasting, impact assessment, and evidence-based resource allocation. This capability is highly relevant for ecotourism destinations because managers need to prevent visitor pressure from exceeding ecological and social carrying capacity. Data-driven insight can help destinations identify high-pressure areas, design alternative routes, improve conservation communication, and support adaptive decision-making.

Proposition 2: *Big Data Analytics Capability strengthens Sustainable Destination Management by improving destination monitoring, visitor impact assessment, demand prediction, and evidence-based resource allocation.*

Blockchain-Enabled Trust Governance can improve Personalized Ecotourism Experience because data-driven personalization requires tourist trust, consent, transparency, and data control. Tourists are more likely to accept personalized recommendations when they understand how their data are collected, processed, shared, and protected. Blockchain-enabled mechanisms can support digital identity, data integrity, consent control, review authenticity, and traceable transactions among tourism stakeholders.



However, blockchain should not be treated as a universal solution for all tourism governance problems. Its implementation in ecotourism may face several limitations, including high implementation costs, limited digital readiness among local tourism actors, interoperability problems across platforms, scalability issues, and dependence on reliable off-chain data. Blockchain can verify records once they are entered into the system, but it cannot automatically ensure that the original data are accurate, fair, or complete. In addition, the immutability of blockchain records may create tension with data protection principles, especially when tourists request correction or deletion of personal information. Therefore, blockchain-enabled tourism governance requires careful institutional design, clear stakeholder responsibility, privacy-sensitive architecture, and alignment with sustainability objectives.

Proposition 3: *Blockchain-Enabled Trust Governance enhances Personalized Ecotourism Experience by strengthening data control, transparency, consent, traceability, and tourist trust in personalized digital services.*

Blockchain-Enabled Trust Governance can also moderate the relationship between Big Data Analytics Capability and Personalized Ecotourism Experience. Big Data Analytics requires reliable and ethically shared data to produce legitimate recommendations. Without trust governance, personalization may generate privacy concerns, resistance from tourists, platform dependency, and distrust among local stakeholders. Blockchain-enabled governance can strengthen the reliability, legitimacy, and acceptability of data-driven personalization.

Proposition 4: *Blockchain-Enabled Trust Governance strengthens the relationship between Big Data Analytics Capability and Personalized Ecotourism Experience by improving the reliability, legitimacy, and acceptability of data-driven recommendations.*

Personalized Ecotourism Experience can improve Sustainable Destination Management when personalization is designed to support conservation learning, visitor dispersion, responsible behavior, and community value creation. Personalization that only follows visitor preference may increase pressure on popular sites. In contrast, sustainability-oriented personalization can redirect visitors to lower-impact alternatives, promote conservation messages, and support local tourism products and services.

In ecotourism destinations, personalization must be more strictly governed than in ordinary leisure tourism because nature-based attractions often involve fragile ecosystems, protected areas, biodiversity resources, cultural landscapes, and local community livelihoods. Personalized recommendations should therefore consider carrying capacity, seasonal ecological sensitivity, conservation rules, visitor density, trail conditions, waste management, and community-based tourism priorities. For example, a recommendation system should not simply direct visitors to the most popular viewpoint, but should be able to suggest alternative routes, distribute visitor flows, deliver conservation messages, and encourage low-impact behavior.



This makes personalized ecotourism a governance mechanism, not merely a marketing instrument.

Proposition 5: *Personalized Ecotourism Experience improves Sustainable Destination Management when personalized recommendations integrate ecological limits, visitor impact control, conservation education, and local community value.*

Accountability, Responsibility, and Transparency Data Governance is necessary because digital tourism systems collect and process large volumes of tourist, business, and destination data. ART Data Governance ensures that Big Data Analytics and blockchain integration remains explainable, fair, traceable, and aligned with sustainable tourism principles. In this framework, ART Data Governance functions as an ethical governance layer that strengthens the legitimacy of digital ecotourism systems.

Proposition 6: Accountability, Responsibility, and Transparency Data Governance strengthens the contribution of Big Data Analytics and blockchain integration to Sustainable Destination Management by improving explainability, fairness, traceability, and stakeholder accountability.

The integration of Big Data Analytics Capability and Blockchain-Enabled Trust Governance can form Digital Ecotourism Governance Capability. Big Data Analytics provides analytical intelligence, while blockchain provides trusted coordination. When both are guided by ART Data Governance, the destination can personalize visitor experience while protecting ecological limits, managing visitor impacts, strengthening stakeholder collaboration, and creating community value.

Proposition 7: *The integration of Big Data Analytics Capability and Blockchain-Enabled Trust Governance creates Digital Ecotourism Governance Capability that supports Personalized Ecotourism Experience and Sustainable Destination Management.*

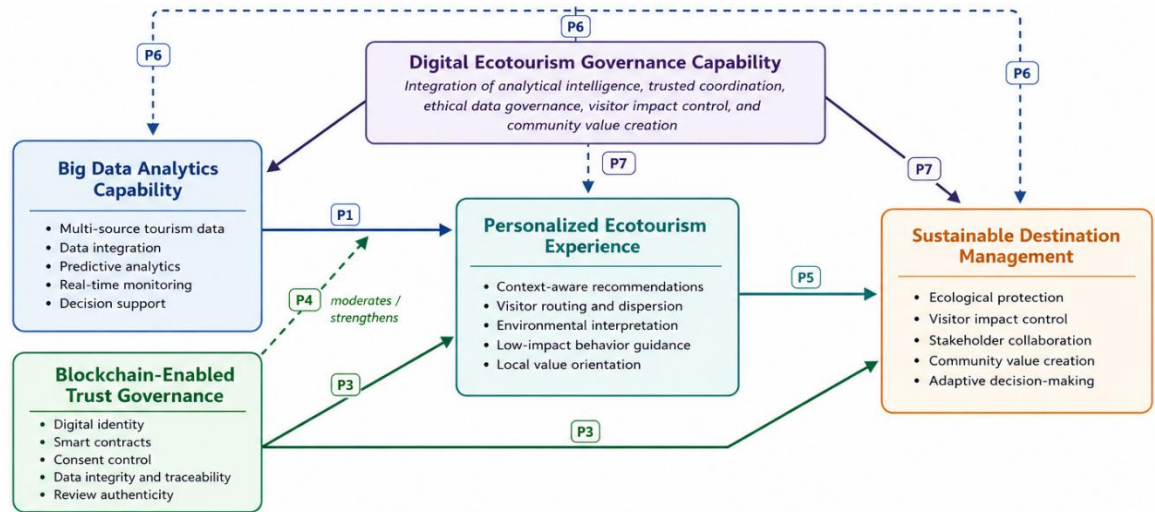


Figure 1. Conceptual Research Framework of Big Data Analytics and Blockchain for Personalized Ecotourism and Sustainable Destination Management.

METHOD

This study employed an integrative conceptual review design to develop a conceptual framework linking Big Data Analytics Capability, Blockchain-Enabled Trust Governance, Personalized Ecotourism Experience, Digital Ecotourism Governance Capability, and Sustainable Destination Management. An integrative review was considered appropriate because the topic is interdisciplinary and requires synthesis across tourism management, smart tourism, digital innovation, data governance, information systems, and sustainability literature. The review procedure was informed by systematic review principles in management research to improve transparency in literature identification, screening, and synthesis. Although this study does not conduct a meta-analysis, the reporting logic follows a transparent literature selection approach adapted from PRISMA 2020 to clarify the search strategy, eligibility criteria, screening process, and synthesis procedure.

The research context of this study is sustainable ecotourism destination management in the digital transformation era. The study focuses on destinations that require visitor management, environmental protection, stakeholder coordination, data-driven decision-making, and personalized visitor services supported by digital technologies. The unit of analysis is scholarly literature discussing Big Data Analytics, blockchain, personalized tourism, ecotourism, smart tourism destinations, data governance, and sustainable destination management.

The literature search was conducted through Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Emerald Insight, SAGE Journals, and Google Scholar for DOI verification and citation traceability. The search used combinations of the following keywords: "big data analytics" AND "sustainable tourism"; "big data" AND "smart tourism destination"; "blockchain" AND "tourism"; "blockchain" AND "hospitality"; "personalized



tourism recommendation”; “personalized ecotourism”; “data governance” AND “tourism”; “visitor management” AND “ecotourism”; and “sustainable destination management” AND “digital technology”. The literature search covered publications from [insert year range, e.g., 2013–2025] and was conducted during [insert search period, e.g., January–March 2026].

The inclusion criteria were: (1) peer-reviewed journal articles or reputable academic sources; (2) publications related to tourism, hospitality, sustainability, information systems, innovation, or destination management; (3) studies discussing at least one core construct of the framework; (4) articles with traceable DOI or stable publisher links; and (5) publications written in English. The exclusion criteria were: (1) non-academic blog posts, commercial reports, and opinion pieces; (2) articles without clear bibliographic information; (3) studies discussing blockchain or big data without relevance to tourism, hospitality, sustainability, or service management; and (4) duplicated records across databases.

The literature selection process consisted of four stages. First, [insert number] records were identified through database and publisher platform searches. Second, [insert number] duplicate records were removed. Third, [insert number] titles and abstracts were screened based on relevance to the core constructs. Fourth, [insert number] full-text articles were assessed for conceptual relevance, methodological quality, and contribution to the proposed framework. The final synthesis included [insert number] articles that directly supported the development of construct definitions, conceptual relationships, and propositions.

The analytical framework followed a concept-centric synthesis approach rather than an author-by-author summary. Each selected article was coded according to construct focus, theoretical contribution, methodological orientation, tourism context, sustainability relevance, and contribution to proposition development. The synthesis procedure involved four steps: identifying construct definitions, comparing conceptual relationships among constructs, grouping studies into thematic clusters, and developing conceptual propositions. The final articles were grouped into five analytical clusters: Big Data Analytics Capability, Blockchain-Enabled Trust Governance, Personalized Ecotourism Experience, Sustainable Destination Management, and Digital Ecotourism Governance Capability.

To enhance analytical rigor, the study prioritized articles from reputable international journals such as *Tourism Management*, *Tourism Management Perspectives*, *Journal of Sustainable Tourism*, *Journal of Hospitality & Tourism Research*, *International Journal of Contemporary Hospitality Management*, *Information Processing & Management*, *Current Issues in Tourism*, *Information Technology & Tourism*, and *Sustainability*. The quality of sources was assessed based on peer-review status, journal relevance, citation traceability, DOI availability, conceptual contribution, and direct relevance to the proposed framework. The final synthesis was used to formulate conceptual propositions explaining how Big Data Analytics and blockchain-enabled trust governance can support personalized ecotourism and sustainable destination management.

**Table 2. Literature Search and Screening Protocol**

Review Component	Description
Review design	Integrative conceptual review
Main databases	Scopus, Web of Science, ScienceDirect, SpringerLink, Taylor & Francis Online, Emerald Insight, SAGE Journals
Supporting source	Google Scholar for DOI verification and citation traceability
Publication period	[insert year range]
Search period	[insert search period]
Main keywords	Big data analytics, sustainable tourism, smart tourism destination, blockchain, hospitality, personalized tourism recommendation, personalized ecotourism, data governance, visitor management, sustainable destination management
Inclusion criteria	Peer-reviewed sources, relevant to tourism/hospitality/sustainability/information systems, related to at least one construct, DOI or stable link available, English language
Exclusion criteria	Non-academic sources, unclear bibliographic information, irrelevant to tourism or sustainability, duplicated records
Final synthesis	[insert number] selected articles

RESULTS AND DISCUSSION

A. RESULTS

The conceptual synthesis produced five main findings. First, Big Data Analytics Capability functions as the intelligence layer of sustainable ecotourism management. It enables destinations to transform multi-source tourism data into visitor insight, demand prediction, spatial monitoring, impact assessment, and decision support. This finding indicates that big data is not only useful for marketing personalization, but also for detecting visitor flows, identifying environmental pressure, and supporting adaptive destination governance.

Second, Blockchain-Enabled Trust Governance functions as the trust and accountability layer of the proposed framework. It supports data integrity, consent control, digital identity, smart contracts, review authenticity, and traceability among tourism stakeholders. This finding shows that blockchain has strategic relevance for ecotourism when it is connected to transparent data sharing, trusted transactions, visitor data control, and stakeholder accountability rather than being treated only as a payment or cryptocurrency tool.

Third, Personalized Ecotourism Experience appears as the central linking mechanism between digital capability and sustainable destination outcomes. Data-driven personalization can improve tourist experience by providing context-aware recommendations, visitor routing, environmental interpretation, and low-impact behavior guidance. However, in ecotourism,



personalization must be designed to support conservation and visitor management because preference-based recommendations without ecological control may increase pressure on fragile sites.

Fourth, ART Data Governance emerges as a necessary ethical condition for integrating Big Data Analytics and blockchain in sustainable ecotourism. Accountability, responsibility, and transparency are important because digital tourism systems depend on continuous data sharing from tourists, platforms, businesses, local communities, and destination authorities. ART principles can reduce privacy risk, strengthen explainability, support stakeholder trust, and improve the legitimacy of data-driven destination decisions.

Fifth, Digital Ecotourism Governance Capability emerges as the integrative outcome of Big Data Analytics Capability, Blockchain-Enabled Trust Governance, and ART Data Governance. This capability explains how ecotourism destinations can combine analytical intelligence and trusted coordination to personalize visitor experiences while protecting ecological limits, controlling visitor impacts, and creating community value.

Table 3. Main Findings of the Conceptual Synthesis

Thematic Finding	Core Interpretation	Implication for the Framework
Big Data Analytics as intelligence capability	Big data supports visitor insight, prediction, segmentation, spatial monitoring, and evidence-based decision-making.	Big Data Analytics Capability becomes the main antecedent of personalized ecotourism and sustainable destination management.
Blockchain as trust governance	Blockchain strengthens transparency, data integrity, consent, traceability, digital identity, and trusted coordination.	Blockchain-Enabled Trust Governance supports personalization and strengthens the legitimacy of data-driven tourism services.
Personalized ecotourism as linking mechanism	Personalization connects visitor preferences with interpretation, routing, conservation education, and responsible behavior.	Personalized Ecotourism Experience explains how digital capability contributes to destination sustainability.
ART data governance as ethical condition	Accountability, responsibility, and transparency prevent irresponsible data use and strengthen stakeholder trust.	ART Data Governance acts as an ethical governance layer for the whole framework.
Digital Ecotourism Governance Capability	Analytical intelligence, trusted coordination, ethical data governance, as visitor impact control, and community	This capability represents the main theoretical contribution of the study.



Thematic Finding	Core Interpretation	Implication for the Framework
integrative concept	value creation are integrated into one governance capability.	

Based on these findings, the study proposes that Big Data Analytics Capability influences Personalized Ecotourism Experience and Sustainable Destination Management. Blockchain-Enabled Trust Governance strengthens the use of data-driven personalization by improving trust, consent, and traceability. Personalized Ecotourism Experience then contributes to Sustainable Destination Management when recommendation systems are aligned with ecological protection, visitor impact control, stakeholder collaboration, and community value creation.

Table 4. Summary of Conceptual Propositions

Proposition	Relationship	Type of Relationship
P1	Big Data Analytics Capability enhances Personalized Ecotourism Experience.	Direct relationship
P2	Big Data Analytics Capability strengthens Sustainable Destination Management.	Direct relationship
P3	Blockchain-Enabled Trust Governance enhances Personalized Ecotourism Experience.	Direct relationship
P4	Blockchain-Enabled Trust Governance strengthens the relationship between Big Data Analytics Capability and Personalized Ecotourism Experience.	Moderating relationship
P5	Personalized Ecotourism Experience improves Sustainable Destination Management.	Direct relationship
P6	ART Data Governance strengthens the contribution of Big Data Analytics and blockchain integration to Sustainable Destination Management.	Governance/enabling condition
P7	Big Data Analytics Capability and Blockchain-Enabled Trust Governance jointly create Digital Ecotourism Integrative proposition Governance Capability.	

B. DISCUSSION

The findings extend smart tourism and sustainable tourism literature by showing that digital transformation in ecotourism should not be understood only as the adoption of advanced technology. Big Data Analytics contributes to destination intelligence, while

blockchain contributes to trust governance, and both must be integrated to produce sustainable value (Balasubramanian et al., 2022; Del Vecchio et al., 2018). This interpretation supports prior studies arguing that smart destinations require technological infrastructure, stakeholder coordination, and sustainability-oriented management logic (Shafiee et al., 2019; Shams et al., 2022).

The proposed framework also extends prior Big Data Analytics studies by shifting the focus from tourist satisfaction and business performance toward sustainable destination governance. Earlier literature shows that big data can improve tourism experience, destination selection, satisfaction, and decision-making (Agrawal et al., 2022; Rahmadian et al., 2022). This study adds that in ecotourism, big data must also support conservation, visitor distribution, ecological monitoring, and community-oriented decision-making (Northcote, 2020; Poudel & Nyaupane, 2013).

The blockchain component strengthens the framework because data-driven personalization requires trust. Tourists may resist personalization when they perceive that their data are collected without control, transparency, or fair value exchange (Line et al., 2020). Blockchain-enabled governance can reduce this concern by supporting consent, traceability, digital identity, and verifiable transactions among tourism actors (Balasubramanian et al., 2022; Kizildag et al., 2020). This argument extends blockchain tourism literature by positioning blockchain as a governance mechanism for sustainable personalization, not merely as a tool for payment, booking, or loyalty systems.

The role of Personalized Ecotourism Experience is theoretically important because it explains how digital capability can become a sustainability mechanism. Personalization can guide tourists toward suitable routes, responsible activities, conservation messages, and less congested sites (Leal et al., 2021; Yang et al., 2024). This finding supports visitor management literature showing that destinations need tools to assess and control visitor impacts across environmental, social, and cultural dimensions (Northcote, 2020). Personalization becomes sustainable only when recommendation systems are designed to balance visitor preference with destination carrying capacity.

The study contributes to theory by integrating four bodies of literature that are often discussed separately: Big Data Analytics, blockchain governance, personalized tourism, and sustainable ecotourism destination management. The concept of Digital Ecotourism Governance Capability becomes the main theoretical contribution because it explains how analytical intelligence and trusted coordination can work together in destination management. This contribution responds to calls for more integrated research on big data governance,



stakeholder relationships, and sustainability in tourism (Rahmadian et al., 2023; Shams et al., 2022).

The main theoretical contribution of this study is the introduction of Digital Ecotourism Governance Capability as a specific conceptual lens for digital transformation in ecotourism destinations. This concept extends smart tourism destination literature by arguing that digital innovation in ecotourism cannot be assessed only through technological infrastructure, service efficiency, or tourist satisfaction. It must also be evaluated through its ability to support ecological protection, visitor impact control, conservation education, stakeholder accountability, and local community value creation. Therefore, this study shifts the discussion from technology adoption to sustainability-oriented digital governance.

From a practical perspective, the proposed framework suggests that destination managers should design digital ecotourism systems that are predictive, ethical, and accountable. Big Data Analytics can be used to monitor visitor movement, identify high-pressure zones, estimate carrying capacity, design alternative routes, and personalize conservation messages. Blockchain can support trusted data sharing, visitor permit management, local product verification, authentic review systems, transparent transactions, and fair benefit distribution among stakeholders.

For protected areas, rural ecotourism destinations, and community-based tourism sites, the framework provides guidance for balancing personalization and sustainability. Personalized recommendation systems should not only direct tourists to attractive locations, but also consider trail conditions, ecological sensitivity, visitor density, seasonal restrictions, community readiness, and conservation priorities. Therefore, destination managers need to integrate digital platforms with local governance mechanisms, visitor education, and community participation

The framework also contributes to Big Data Analytics literature by positioning analytics as a destination governance capability rather than merely a marketing or business intelligence tool. In ecotourism, Big Data Analytics is valuable when it helps managers understand visitor behavior, predict demand, monitor environmental pressure, and design adaptive responses to ecological and social limits. This perspective broadens the role of analytics from personalization to responsible destination management.

Furthermore, the blockchain component contributes to tourism technology literature by positioning blockchain as a trust governance mechanism. Rather than limiting blockchain to payment, booking, loyalty systems, or review verification, this study explains how blockchain can support consent control, data integrity, transparent stakeholder coordination, and accountability in personalized ecotourism systems. This strengthens the conceptual link between digital trust and sustainable tourism governance



For practice, the framework suggests that destination managers should build data systems that are not only predictive but also ethical and accountable. Ecotourism destinations can use Big Data Analytics to monitor visitor movement, identify high-pressure areas, design alternative routes, and personalize conservation messages. Blockchain can be used to strengthen trusted data sharing, verify local products or services, manage visitor permits, authenticate reviews, and ensure transparent benefit distribution among stakeholders. ART Data Governance should guide these practices so that tourists, communities, businesses, and public authorities understand how data are collected, processed, shared, and used.

For future research, the proposed framework can be tested empirically using quantitative, qualitative, or mixed-method designs. Quantitative studies may examine the effect of Big Data Analytics Capability and Blockchain-Enabled Trust Governance on Personalized Ecotourism Experience and Sustainable Destination Management. Qualitative studies may explore how destination managers, local communities, tourists, and technology providers perceive trust, data control, and sustainability in digital ecotourism systems. Mixed-method studies may combine visitor analytics, interviews, and destination impact indicators to evaluate whether personalized ecotourism systems can reduce environmental pressure while improving visitor experience.

Future research can empirically test the proposed framework using quantitative, qualitative, or mixed-method designs. Quantitative studies may examine the effect of Big Data Analytics Capability and Blockchain-Enabled Trust Governance on Personalized Ecotourism Experience and Sustainable Destination Management. Personalized Ecotourism Experience can also be tested as a mediating variable, while Blockchain-Enabled Trust Governance and ART Data Governance can be examined as moderating or enabling conditions.

Qualitative studies may explore how destination managers, local communities, tourists, technology providers, and public authorities perceive digital trust, data control, visitor monitoring, and sustainability in ecotourism destinations. Mixed-method studies may combine visitor analytics, interviews, observation, and destination impact indicators to evaluate whether personalized ecotourism systems can reduce environmental pressure while improving visitor experience and community value

CONCLUSION

This study developed a conceptual framework explaining how Big Data Analytics and blockchain-enabled trust governance can support Personalized Ecotourism and Sustainable Destination Management. The objective of the study has been achieved by synthesizing literature on Big Data Analytics Capability, Blockchain-Enabled Trust Governance, Personalized



Ecotourism Experience, ART Data Governance, and Sustainable Destination Management into an integrated conceptual model.

The study shows that Big Data Analytics functions as an intelligence capability for understanding visitor behavior, predicting demand, monitoring destination pressure, and supporting evidence-based decision-making. Blockchain complements this capability by strengthening trust, transparency, data integrity, consent control, traceability, and stakeholder accountability. Personalized Ecotourism Experience functions as the linking mechanism through which digital capability can contribute to sustainability-oriented destination outcomes.

The key theoretical contribution of this study is the concept of Digital Ecotourism Governance Capability. This concept explains that sustainable ecotourism requires more than digital technology adoption. It requires the integration of analytical intelligence, trusted coordination, ethical data governance, visitor impact control, and community value creation. This contribution extends smart tourism, sustainable tourism, blockchain tourism, and data governance literature by offering a specific conceptual lens for ecotourism destinations.

Practically, the framework provides guidance for destination managers to design digital ecotourism systems that personalize visitor experience while protecting ecological limits, improving visitor management, supporting conservation education, and strengthening community value creation. The framework also suggests that digital personalization must be governed by accountability, responsibility, transparency, consent, explainability, and stakeholder participation.

This study has several limitations. First, the framework is conceptual and has not yet been empirically tested. Second, the study relies on literature-based synthesis, so the proposed propositions require validation in real destination settings. Third, the framework does not focus on one specific country, destination type, or ecotourism segment, which limits contextual specificity. Future research may test the proposed model using survey data from tourists, destination managers, local communities, or ecotourism stakeholders. Further studies may also apply qualitative case studies or mixed-method approaches to examine how blockchain-enabled data governance operates in protected areas, rural ecotourism destinations, and smart tourism destinations.

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DECLARATION ON THE USE OF AI-ASSISTED TECHNOLOGIES

The authors declare that AI-assisted technology was used in the preparation of this manuscript. OpenAI ChatGPT was used to assist with language drafting, manuscript structuring,



conceptual clarification, and the preparation of the research framework figure. The AI-assisted output was reviewed, revised, and verified by the authors. The authors remain fully responsible for the accuracy, originality, integrity, references, conceptual arguments, figures, and ethical accountability of the submitted manuscript.

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