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Developing Sustainable Tourism in Mining Heritage Sites: Finding Equilibrium between Conservation and Visitor Engagement at Dhori Mines, India

Aditi Nag*

School of Architecture and Design, Manipal University Jaipur, Jaipur, Rajasthan, India

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Abstract

Using quantitative data from visitor surveys, Environmental Impact Assessments (EIA), and stakeholder perspectives, this paper investigates the growth of sustainable tourism at Dhori Mines, a noteworthy mining heritage site (MHS) in India. The survey reveals that 82% of visitors value a site's heritage value and prefer immersive experiences that highlight its cultural and historical significance, highlighting the complex relationship between conservation efforts and visitor engagement. The EIA revealed that 68% of regions experienced moderate to severe environmental degradation, and water contamination increased by 22% since baseline measurements. The findings suggest targeted measures to reduce environmental effects and encourage ethical tourism, emphasizing the importance of inclusive decision-making and collaborative governance in balancing conservation objectives with visitor satisfaction. Developing tailored visitor experiences, implementing sustainable practices based on EIA data, and enhancing community participation are merely some of the important recommendations made in the paper's conclusion. The research provides managers and policymakers with evidence-based recommendations for preserving the environmental sustainability and cultural integrity of MHSs like Dhori Mines, contributing to the growing knowledge on sustainable heritage tourism. Future research prospects include long-term monitoring of environmental impacts, assessing socio-economic outcomes for local communities, and conducting comparative studies across different MHSs.

1. Introduction

Sustainability is now a widely accepted ethical notion. Modern society has developed to conform to specific ethical norms. The notion of sustainability has spread throughout the world, impacting our attitudes and beliefs about recreational pursuits [1]. In spite of obstacles related to politics, economy, and health, tourism is still setting records. These travel-related industries include luxury, coastal, nature, interior, rural, urban, heritage, architectural, conference, cultural, ethnographic, adventure, shopping, travel for children, families, teenagers, elderly, or the LGBTQ+ community, cemetery, grief, literary, war, dark, ornithological, cinema, alcohol, health, gastronomic, religious, magic, fashion, sex, sports, events, and industrial travel [1–7]. These industries grew as a result of the rise in leisure travel in the last decades of the 20th century.

In recent years, there has been a shift towards cultural tourism, focusing on personalised experiences and exploring the past, cultural heritage, traditions, customs, and lifestyle of locals at the destination [2-3]. This type of tourism combines leisure time with education, aiming to educate visitors about the significance, values, and effects of a new cultural legacy on society [5-7]. "Heritage tourism" is a subset of cultural tourism [8]. The emergence of cultural tourism in the last two decades of the 20th century was driven by the shift from an industrial to a post-industrial society, economic transformation, new technologies, and labour market adjustments [7]. This led to the

Corresponding author: ar.aditi204@gmail.com (A. Nag)

emergence of a diverse range of industrial legacy, including mining and heavy industries [6]. Mining for mineral wealth created a distinct culture and employed a large number of people, but the deindustrialization process and mining area transformation are rapidly occurring [5-7]. Disappearing relics can be seen as valuable components of our legacy, contributing to its preservation [7]. Cultural tourism is a way to ensure these relics are preserved and transmitted to a larger audience and future generations [6].

The deindustrialization process has led to the transformation or disappearance of many industrial sites. Industrial heritage tourism seeks to revitalize these sites, turning them into valuable cultural assets. Industrial heritage tourism focuses on promoting a location's industrial past, including mines, factories, and related artefacts. This historical significance justifies its revitalization and reinterpretation today [8]. Examples of transformed industrial sites include Ironbridge and Zollverein, which have become eco-museums and historical parks, thereby expanding industrial heritage tourism globally [9]. While active factories are not typically viewed as heritage, many abandoned industrial sites are repurposed for tourism or left idle, awaiting redevelopment. The Spanish National Plan for Industrial Heritage defines industrial heritage as encompassing assets related to working-class culture, allowing for the transformation of abandoned sites into visitor attractions [9].

The decision to focus on balancing conservation and visitor experience in this study stems from the recognition that these two elements are crucial for the sustainable development of mining heritage tourism (MHT). Unlike other indexes, such as economic impact or visitor numbers alone, the interplay between conservation and visitor experience directly influences the long-term viability of heritage sites. Effective management of this balance ensures that these sites can be appreciated by future generations while also providing educational and immersive experiences for current visitors. This research contributes to the existing body of knowledge by addressing the often-overlooked complexities of managing mining heritage sites (MHSs) in a way that honours their historical significance while accommodating the needs and expectations of modern visitors. While existing studies have explored either conservation or visitor experience independently, this research addresses the intersection of these aspects. Several researches [1-38] highlight the importance of integrating visitor experience into conservation strategies. However, specific studies focusing on MHSs and their unique challenges remain limited. This research fills this gap by examining how to effectively balance these priorities, offering new insights into the management of MHSs. This study's choice to focus on balancing conservation and visitor experience, rather than other indexes, is driven by the complex nature of MHSs. These sites present unique challenges due to their environmental impacts and historical significance. The novelty lies in its comprehensive approach, integrating recent advancements in sustainable tourism practices and emphasizing the importance of community engagement and education in fostering a culture of conservation among visitors. The upcoming sections will provide background and context on the importance of balancing conservation and visitor experience in MHT. The research objectives and methodology will be outlined, followed by a literature review covering the conceptual framework of sustainable tourism, tourism development in MHSs, conservation challenges and strategies, visitor experience enhancement, and ecological sustainability in tourism. The results, discussion, and conclusion sections will synthesize the key findings and provide recommendations for policymakers, planners, and practitioners in the field of heritage tourism.

1.1. Background and Context

Mining heritage landscapes (MHL) are very desirable tourist sites because they are rich in historical, cultural, and ecological significance [5, 7]. To ensure long-term sustainability, however, the growth of tourism in these regions necessitates a sophisticated strategy that carefully strikes a balance between conservation objectives and the improvement of visitor experiences. These landscapes provide deep insights into our common history and the relationship between industrial activity and natural ecosystems. They also act as living archives of human creativity, societal evolution, and environmental adaptability [10–12].

MHL hold significant historical and cultural significance, representing the transformative impact of mining on societies, economies, and landscapes over centuries. These sites are not just remnants of past industrial activities but also symbols of human endeavour, resilience, and progress [8, 10]. They represent the heritage and traditions of mining communities, reflecting local knowledge, customs, and rituals in art, music, folklore, and culinary traditions [12-14]. Preserving and interpreting this cultural heritage

fosters cultural appreciation, identity formation, and intergenerational dialogue within communities and among visitors. In addition to their historical and cultural dimensions, MHL hold ecological significance and potential for regeneration [15-16]. Many abandoned mining sites have undergone natural regeneration processes, leading to the formation of unique ecosystems with specialized flora and fauna [16]. Sustainable land management practices, such as reforestation, soil rehabilitation, and water management, can transform degraded mining areas into thriving habitats, contributing to biodiversity conservation, landscape rehabilitation, and promoting sustainable land use practices [17]. The growing interest in sustainable tourism within MHL reflects broader societal trends and values [7]. Sustainable tourism practices, characterized by responsible travel, cultural immersion, and environmental stewardship, resonate with travellers seeking authentic experiences that support local communities and conserve natural and cultural heritage [18-22]. MHT presents economic opportunities for local communities, driving heritage preservation, job creation, and economic diversification [17-19]. As MHL attract increasing attention as tourism destinations, the need for balanced development becomes paramount [20]. Balancing conservation imperatives with visitor experience enhancement is essential for ensuring the long-term viability and resilience of these landscapes. Effective management strategies, informed by stakeholder collaboration, community engagement, and sustainable tourism practices, can contribute to the preservation of MHL while maximizing their potential as sustainable tourism destinations [23-24].

MHL are living, breathing examples of the nexus between cultural identity, ecological restoration, and human history. They are more than just historical artefacts. Sustainable tourism development in these environments highlights the significance of comprehensive, responsible approaches to tourism that honour our legacy while preserving our world for future generations. It also presents opportunities for education, conservation, economic growth, and community empowerment.

1.2. Importance of Balance

MHL are not only historical and cultural treasures but also ecologically significant areas that attract visitors seeking unique experiences. These landscapes frequently include abandoned mines, industrial buildings, and reclaimed land—relics from previous mining operations. They are fascinating visitor attractions because they are dynamic examples of industrial evolution, human inventiveness, and environmental adaptation [25]. The intricate interplay of several aspects necessitates a thorough evaluation of the delicate balance between conservation efforts and visitor experience enhancement in MHL. Restoration and preservation initiatives, habitat protection, environmental monitoring, and cultural heritage management are all part of the conservation efforts in MHL [26–28]. MHL are significant sites that hold historical structures, artefacts, and cultural landscapes. Environmental conservation measures, such as habitat restoration, water quality management, and pollution remediation, are also essential for protecting biodiversity and ecosystem health [5, 29]. Cultural conservation initiatives document oral histories, traditional knowledge, and intangible heritage associated with mining communities to ensure they are not lost to time [30-31].

Visitor experience enhancement is essential for sustainable tourism development in MHL [1-3]. This involves creating opportunities for meaningful engagement, education, and enjoyment, such as interpretive programs, guided tours, interactive exhibits, and hands-on activities [32-33]. Sustainable tourism practices, such as responsible travel behaviour, low-impact infrastructure, and community involvement, are vital for ensuring positive visitor experiences for both visitors and host communities [1, 34-36]. Significantly important is the economic aspect of tourism in MHSs. Tourism contributes to economic growth and development by generating income, opening up job opportunities, and boosting local economies [5-7]. However, in order to prevent overdevelopment, depletion of natural resources, and cultural commercialisation, the economic advantages need to be weighed against conservation priorities [37–38]. Planning for sustainable tourism can assist minimise negative effects while optimising the benefits of tourism to the environment and community well-being. Examples of such planning include carrying capacity evaluations, visitor management tactics, and revenue-sharing mechanisms.

However, finding the right balance between conservation imperatives and visitor experience enhancement is challenging. Overemphasis on tourism development without adequate conservation measures can lead to negative impacts, while overly stringent conservation measures may limit visitor access and experiences,

reducing the socio-economic benefits of tourism for local communities [4-11]. A holistic approach that integrates conservation principles with sustainable tourism practices is essential, involving comprehensive planning, stakeholder engagement, adaptive management, and monitoring to ensure tourism activities align with conservation goals [28, 39-40]. By valuing and integrating conservation principles with responsible tourism practices, MHL can thrive as vibrant, authentic, and resilient attractions that preserve their heritage, protect their ecosystems, and provide enriching experiences for visitors.

1.3. Research Objectives

The objectives of this research are to ascertain sustainable tourism practices in MHL, assess conservation measures, and comprehend visitor perspectives. It examines important elements affecting visitors' experiences, evaluates the success of conservation activities, and pinpoints the best methods for developing tourism responsibly. The study provides insightful information that can be used to manage MHL sustainably, striking a balance between the growth of tourism and the protection of cultural assets and the environment. Table 1 lists the objectives and research questions of the study.

Table 1. Study's Research Objectives and Questions (Source: Author)

Obj. 1: Evaluate conservation strategies and their impact on heritage preservation	Obj. 2: Understand visitor perceptions and preferences in MHL	Obj. 3: Identify sustainable tourism practices that promote ecological, cultural, and economic sustainability
• How effective are existing conservation strategies in maintaining heritage and ecological integrity within mining landscapes?	• What insights can be gained from other heritage tourism locations to enhance sustainability and visitor satisfaction in mining landscapes?	
	• What key factors shape visitor perceptions and experiences in MHSs?	• Which sustainable tourism practices have proven successful in MHL, and how do they positively impact visitor experiences and conservation efforts?
• In what ways do visitor perceptions align with conservation objectives in mining landscapes, and what potential conflicts or synergies may exist?		
• How can various stakeholders work together to achieve a balance between tourism growth and conservation in mining heritage areas?		

1.4. Overview of Methodology

This paper explores key themes for sustainable tourism development in MHL, including visitor experience enhancement, conservation strategies, sustainable tourism practices, and ecological sustainability (refer Figure 1). It aims to understand how these elements contribute to the management and preservation of MHSs.

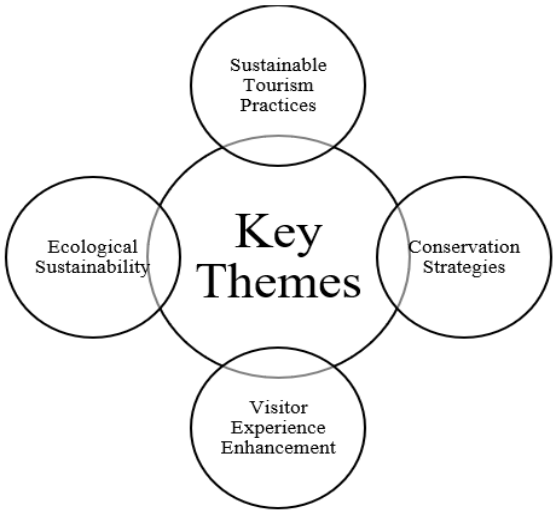

Figure 1. Key themes for exploration (Source: Author)

The study uses a mixed-methods approach to understand visitor perceptions and expectations in MHL. Surveys capture visitor experiences and motivations, while environmental impact assessments (EIAs) evaluate conservation strategies' effectiveness on ecological sustainability. Stakeholder consultations involve tourism operators, government agencies, local communities, and conservation organizations. These consultations help identify challenges, understand different viewpoints, and explore collaborative solutions for sustainable tourism development. The approach aims to provide valuable data on habitat restoration, pollution mitigation, and overall ecosystem health.

2. Literature Review

The literature review section of this study delves into a comprehensive analysis of key themes and concepts related to sustainable tourism development in MHL. The subsequent sections will explore various aspects, starting with the conceptual framework of sustainable tourism, followed by an examination of tourism development in MHSs, conservation challenges and strategies, visitor experience enhancement, and ecological sustainability in tourism. The literature selection process involved a rigorous and

comprehensive approach, including sourcing relevant studies from reputable databases such as Web of Science, ScienceDirect, and other research platforms. This ensures that the literature review provides a robust foundation for understanding the complexities and dynamics of sustainable tourism in the context of MHL.

2.1. Conceptual Framework of Sustainable Tourism

The conceptual framework of sustainable tourism in heritage landscapes is rooted in the integration of environmental conservation [16, 27, 41], cultural preservation [20-22], and community engagement [5, 37, 42-43] principles. This framework is guided by various theories and models that inform research and practice in sustainable tourism development. Table 2 delves deeper into these theories and models to understand their applicability and significance in the context of heritage landscapes.

Applying these theories and models in the context of sustainable tourism in heritage landscapes requires a holistic and interdisciplinary approach that considers environmental, cultural, social, and economic dimensions [44-59]. It involves collaboration among multiple stakeholders, including government agencies, tourism industry stakeholders, local communities, conservation organizations, academia, and visitors themselves [60-62]. By adopting a sustainable tourism framework grounded in these theories and models, heritage destinations can achieve a balance between tourism development and conservation objectives, creating authentic, enriching, and resilient tourism experiences for visitors while preserving the heritage, environment, and livelihoods of local communities for future generations.

Table 2. Theories and models in heritage landscapes (Source: Author's compilation)

Theories and Models	Applicability and Significance in the context of heritage landscape	References
Triple Bottom Line (TBL) Theory	Balances environmental, social, and economic factors in sustainable development. Ensures tourism contributes to environmental conservation, cultural preservation, and economic growth without harming heritage landscapes.	[44-47]
Carrying Capacity Theory	Determines the maximum number of visitors a destination can accommodate sustainably. Considers visitor numbers, infrastructure, waste management, and environmental impacts to maintain ecological integrity and cultural authenticity.	[48-51]
Community-Based Tourism (CBT) Model	Involves local communities in tourism planning and benefits-sharing. Promotes cultural authenticity, social inclusivity, and equitable distribution of tourism benefits by empowering local residents.	[52-55]
Destination Management Organizations (DMOs)	Coordinates sustainable tourism development at the destination level. Integrates sustainability principles into policies, marketing, infrastructure, and visitor management, promoting responsible tourism and community engagement.	[56-58]
Cultural Heritage Management Theories	Guides preservation, interpretation, and promotion of cultural heritage in tourism. Ensures authentic and meaningful visitor experiences while safeguarding cultural heritage assets.	[59-60]
Environmental Impact Assessment (EIA)	Evaluates potential environmental impacts of tourism activities. Identifies risks and informs sustainable development strategies to protect natural resources and ensure environmental sustainability.	[61-64]

2.2. Tourism Development in Mining Heritage Sites

Tourism development in MHSs represents a compelling intersection of historical legacy, cultural significance, and natural landscapes, drawing attention to the evolving narrative of industrial heritage tourism [65-66]. These sites, often characterized by abandoned mines, industrial ruins, and reimagined landscapes, have emerged as focal points for heritage tourism, attracting visitors seeking immersive experiences and historical insights [67]. The exploration of MHL not only unravels the technological advancements and economic contributions of past mining activities but also provides a platform for reflecting on societal transformations, environmental impacts, and community resilience over time.

MHSs possess intrinsic heritage value and cultural significance, serving as tangible reminders of industrial prowess, labour struggles, and technological innovations [55, 64]. The preserved structures, artefacts, and landscapes within these sites narrate stories of human endeavour, ingenuity, and adaptation to challenging environments. Visitors are drawn to the authenticity and tangible links to the past that MHL offer, allowing them to connect with history, heritage, and industrial evolution in meaningful ways [68-69]. The tourism potential of MHSs lies in their ability to offer unique and immersive experiences to visitors. Interpretive programs, guided tours, hands-on

activities, and interactive exhibits provide avenues for engaging visitors and enhancing their understanding of mining heritage [20, 51, 55, 64-68]. These experiential offerings not only educate but also entertain, fostering a deeper appreciation for the historical, cultural, and environmental dimensions of MHL [1-5]. However, the development of tourism in MHSs comes with its set of challenges and opportunities. Environmental degradation, infrastructure limitations, heritage preservation concerns, community engagement issues, and economic sustainability are key challenges that require careful consideration in tourism planning and management [64-67]. Balancing conservation efforts with visitor experience enhancement is crucial for ensuring the long-term sustainability and authenticity of tourism development in these landscapes.

In light of these complexities, this section explores the multifaceted aspects of tourism development in MHSs, delving into the heritage value, tourism potential, challenges, opportunities, and best practices that underpin sustainable tourism initiatives in these unique landscapes. Through a comprehensive examination of existing literature and theoretical frameworks, this research seeks to contribute valuable insights to the sustainable management and promotion of tourism in MHSs, addressing the intricate dynamics of heritage conservation, visitor engagement, and community empowerment (refer Table 3).

Table 3: Key findings and gaps analysis (Source: Author's compilation)

Section	Aspects	Insight from previous studies	References
Key Findings	**Heritage Value**	Many studies highlight the significant heritage value of mining sites, emphasizing their historical, cultural, and industrial importance. These sites often hold tangible and intangible heritage assets that attract visitors interested in industrial history, technological advancements, and cultural narratives.	[59-60, 64-67]
	Tourism Potential	There is consensus among researchers that MHSs have significant tourism potential, offering unique experiences and opportunities for cultural tourism, heritage interpretation, and educational activities. Visitors are attracted to the authenticity, uniqueness, and storytelling aspects of these landscapes.	[17, 25, 33, 65-66]
	Challenges	Several challenges have been identified in tourism development at MHSs, including environmental degradation, infrastructure limitations, heritage preservation concerns, community engagement issues, and economic sustainability. Managing these challenges requires integrated approaches that balance tourism growth with conservation imperatives.	[50-53, 68-69]
	Visitor Experience	Studies emphasize the importance of enhancing visitor experiences through interpretive programs, guided tours, interactive exhibits, and immersive activities. Engaging visitors in meaningful experiences fosters a deeper connection with the heritage and promotes appreciation for conservation efforts.	[5-7]
	Conservation Strategies	Effective conservation strategies are crucial for preserving heritage assets and ecological integrity in mining landscapes. These strategies often involve habitat restoration, pollution mitigation, cultural preservation, and community involvement to ensure sustainable tourism development.	[4-7]
Gaps in Knowledge	**Sustainability Metrics**	There is a need for standardized sustainability metrics and performance indicators specific to MHT. Measuring the sustainability of tourism activities in these landscapes requires comprehensive frameworks that integrate environmental, socio-cultural, and economic dimensions.	[11, 20-27]
	Community Involvement	More research is needed on effective community engagement strategies and benefits-sharing mechanisms in tourism development. Empowering local communities as partners in tourism planning and management can enhance authenticity, social inclusivity, and economic opportunities.	[36, 55-58]
	Visitor Behaviour	Understanding visitor behaviour, motivations, and preferences in MHL is essential for designing tailored experiences and managing visitor impacts. Research on visitor demographics, travel patterns, spending behaviours, and satisfaction levels can inform targeted marketing strategies and sustainable tourism initiatives.	[5-7, 57-59]
Areas of Consensus	**Importance of Interpretation**	There is consensus on the importance of interpretation and storytelling in heritage tourism. Interpretive programs that convey the historical, cultural, and environmental significance of mining sites enhance visitor understanding and engagement.	[68-69]
	Sustainable Practices	Researchers agree on the necessity of adopting sustainable tourism practices in MHL. Sustainable practices include responsible visitor behaviour, eco-friendly infrastructure, waste management, energy conservation, and cultural sensitivity.	[1-7, 52-57]
Areas of Contention	**Commercialization vs. Conservation**	One area of contention is the balance between commercialization of tourism activities and conservation of heritage assets. Some studies argue that commercialization can lead to commodification and loss of authenticity, while others suggest that sustainable tourism can support conservation efforts through revenue generation.	[15-19, 22-23, 56-60]
	Conflict Resolution	Resolving conflicts between tourism development, conservation goals, and community interests remains a contentious issue. Stakeholder conflicts, land use conflicts, and competing priorities often require mediation, collaboration, and adaptive management approaches.	[1-7, 15-19, 22-23, 56-60]

The research on the development of tourism in MHSs places a strong emphasis on the value of conservation strategies, visitor experiences, community involvement, and sustainable practices [70-72]. Although there are still gaps in our understanding, everyone agrees that MHT has great promise and that comprehensive strategies are needed to combine financial gains with the preservation of cultural assets and the sustainability of the environment. Subsequent investigations ought to tackle lacunae in understanding, gauge sustainability results, augment community engagement, and settle disputes.

2.3. Conservation Challenges and Strategies

Conservation challenges specific to MHSs pose intricate dilemmas in preserving natural and cultural heritage while fostering sustainable tourism [67-69]. These sites, laden with historical legacies of industrial activity, confront environmental degradation, heritage preservation concerns, community engagement complexities, and the imperative to balance conservation with tourism development [5, 70-73]. The delicate interplay between safeguarding natural ecosystems, protecting cultural artefacts, empowering local communities, managing visitor impacts, and promoting sustainable practices underscores the multifaceted nature of conservation efforts in MHL [50-55]. In navigating these challenges, strategic conservation strategies and collaborative partnerships play pivotal roles in ensuring the long-term integrity and sustainability of these unique heritage sites amidst tourism pressures (refer Table 4).

Table 4. Strategies, challenges, and conservation-related aspects (Source: Author's compilation)

Aspects	Challenge	Strategy	References
Environmental Degradation	Soil erosion, water pollution, habitat destruction, and land subsidence from historic mining.	Environmental remediation and restoration: reforestation, wetland restoration, water quality management, soil stabilization.	[66-69]
Heritage Preservation	Threats to MHSs: neglect, weathering, vandalism, lack of maintenance.	Heritage conservation programs: documentation, structural assessments, conservation treatments, interpretation efforts.	[12, 33, 60]
Community Engagement	Balancing local community interests with tourism development.	Engage communities in tourism: capacity building, community-based tourism, cultural heritage programs.	[36, 55-58]
Visitor Management	Overcrowding, littering, habitat disturbance, cultural insensitivity.	Visitor management plans: guided tours, signage, education, designated trails, waste management.	[5-7, 57-59]
Sustainable Development	Balancing tourism with environmental, economic, and social sustainability.	Sustainable practices: eco-friendly infrastructure, green technologies, community tourism, local sourcing.	[1-7, 52-57]
Collaborative Partnerships	Coordinating efforts among stakeholders.	Build partnerships: public-private collaborations, heritage networks, stakeholder forums.	[2-11, 15-19, 22-23, 56-60]

MHSs may preserve their natural and cultural heritage assets and encourage sustainable tourism that benefits both visitors and local communities by tackling these conservation issues and putting planned interventions into place [52-60, 66-69].

2.4. Visitor Experience Enhancement

Visitors seeking genuine, enriching experiences with a strong historical foundation are increasingly drawn to heritage tourism, which is defined by visits to historical, cultural, and natural sites. Enhancing visitor experiences, which includes a variety of tactics like interpretative programs and community involvement, is essential to the success of heritage tourism [5-7, 57-59]. This investigation explores the various strategies employed to improve visitor experiences in heritage tourism (refer Table 5), emphasising the development of interpretive programs, infrastructure, and the critical role that community engagement plays in fostering meaningful and long-lasting relationships with heritage sites.

Infrastructure development, community involvement, and interpretative programs are ways to improve heritage tourism [70]. These methods produce engaging, instructive, and long-lasting experiences that honour regional history and support the conservation and appreciation of natural and cultural assets for coming generations. Heritage tourism places can offer unforgettable experiences by incorporating these tactics [71-72].

Table 5. Strategies for enhancing heritage tourism visitor experience (Source: Author's compilation)

Approach	Visitor experience enhancement	References
Interpretive Programs	• Immersive tools that engage visitors and deepen their understanding of heritage sites. • Programs go beyond information dissemination to evoke emotions, spark curiosity, and foster connections. • Forms include guided tours, interactive exhibits, storytelling sessions, and multimedia presentations. • At MHSs, programs may showcase technological innovations, labour history, environmental impacts, and cultural significance. • Aim to create memorable and transformative experiences, leading to a deeper appreciation of heritage sites.	[5-7]
Infrastructure Development	• Crucial in shaping visitor experiences in heritage tourism. • Well-designed facilities, amenities, and signage enhance visitor experience and site preservation. • Visitor centres provide orientation, information, and educational resources. • Walking trails with interpretive signage guide visitors through historical landmarks, natural features, and cultural points of interest. • Viewing platforms offer panoramic views of heritage landscapes. • Rest areas, picnic spots, and accessible facilities cater to diverse visitor needs. • Digital technologies, such as mobile apps, virtual tours, and AR experiences, enhance interpretive value. • Supports sustainable tourism by minimizing environmental impacts and promoting responsible behaviour.	[57-58]
Community Involvement	• Integral to creating authentic and inclusive visitor experiences. • Local communities play a vital role in shaping the narrative and interpretation of heritage sites. • Engaging communities in tourism planning and benefits-sharing empowers them as cultural ambassadors. • Forms include community-led tours, cultural performances, craft demonstrations, and heritage workshops. • Promotes cultural authenticity, supports economic development, and strengthens social cohesion. • Enhances authenticity and diversity of visitor experiences while preserving and celebrating local heritage.	[57, 59, 73-76]

2.5. Ecological Sustainability in Tourism

Due to the pressing need to reduce environmental consequences, encourage ethical travel habits, and protect biodiversity, ecological sustainability in tourism has gained attention in current discussions [8, 27, 77-80]. This literature review explores the various approaches and research outcomes related to these important facets of ecological sustainability (refer Table 6). This review examines studies on protected areas management, certification programs, education campaigns, ecotourism initiatives, and EIAs in an effort to shed light on how sustainable tourism practices are changing and how they should balance tourism growth with biodiversity preservation and environmental conservation.

Sustainable tourism practices are designed to reduce the negative effects that tourism has on the environment, including carbon emissions, pollution, habitat destruction, and resource depletion [78]. Strategies include the creation of environmentally friendly infrastructure, waste management programs, energy-saving techniques, environmentally friendly transportation options, and conservation efforts [70-72]. Programs for eco-certification urge companies and travel destinations to use eco-friendly practices [76-80]. Supporting local communities, preserving the environment, honouring local customs, and travelling ethically are all encouraged by responsible tourism [65, 86-87]. Programs for visitor education and awareness are crucial. The implementation of responsible tourism programs necessitates cooperative collaborations among stakeholders, governments, non-governmental organisations, and local people [88]. An essential part of ecological sustainability in tourism is biodiversity conservation. Conservation zones include marine reserves, wildlife sanctuaries, and protected regions [89]. Sustainable practices in wildlife tourism offer chances for pleasure and education while also helping to conserve biodiversity [90]. Achieving sustainable tourism outcomes requires proactive measures including strict impact evaluations, certification programs, awareness campaigns, managed protected areas, and ecotourism projects.

Table 6. Ecological sustainability drivers, strategies and effects in tourism (Source: Author's compilation)

Drivers	Strategies	Effects	References
Mitigating Environmental Impacts	**Environmental Impact Assessments (EIA)**	EIAs are essential tools for evaluating the potential environmental effects of tourism development projects. Research by Hall [65] emphasizes the importance of comprehensive EIAs in identifying and mitigating impacts on air quality, water resources, wildlife habitats, and cultural heritage.	[61-65]
	Carrying Capacity Studies	Studies by Gössling et al. [52] highlight the significance of carrying capacity assessments in determining the maximum number of visitors a destination can sustainably accommodate without degrading environmental quality. These studies inform tourism planning and management strategies to prevent overcrowding, resource depletion, and ecosystem degradation.	[48-52]
Promoting Responsible Tourism Practices	**Certification Programs**	Certification programs such as EarthCheck and Green Globe play a crucial role in promoting responsible tourism practices. Research by Weaver and Moyle [81] suggests that certified sustainable tourism businesses adhere to environmental standards, reduce resource consumption, minimize waste generation, and engage in community-based initiatives.	[2-11, 15-19, 22-23, 81]
	Educational Campaigns	Educational campaigns and visitor awareness programs are effective in encouraging responsible behaviour among visitors. Studies by Wondirad et al. [82] emphasize the role of interpretation, signage, and visitor education in promoting waste reduction, energy conservation, water conservation, and cultural respect.	[5-7, 82]
Preserving Biodiversity	**Protected Areas Management**	Management of protected areas is vital for biodiversity conservation in tourism destinations. Research by Buckley and Underdahl [83] discusses the challenges and opportunities of integrating biodiversity conservation objectives into tourism management plans, including habitat restoration, species protection, and ecosystem resilience.	[4-7, 12, 33, 60, 83]
	Ecotourism Initiatives	Ecotourism initiatives, when properly designed and managed, contribute to biodiversity conservation and community development. Studies by Foley [84] and Fennell [85] highlight successful ecotourism projects that support habitat conservation, wildlife protection, and local livelihoods while providing meaningful experiences for visitors.	[5-7, 84-85]

3. Methodology

The methodology section of this research presents a systematic and rigorous approach that combines quantitative and qualitative methods, known as a mixed-methods approach. This comprehensive strategy integrates data collection techniques, data analysis methods, and a methodology flowchart to provide a nuanced understanding of the research topic. The following sections elaborate on the research design, data collection methods, data analysis techniques, and the integration of quantitative and qualitative data, demonstrating how this mixed-methods approach is utilized to achieve robust insights and triangulate findings. The methodology flowchart is also presented to visualize the sequential steps undertaken in the research process (refer Figure 2).

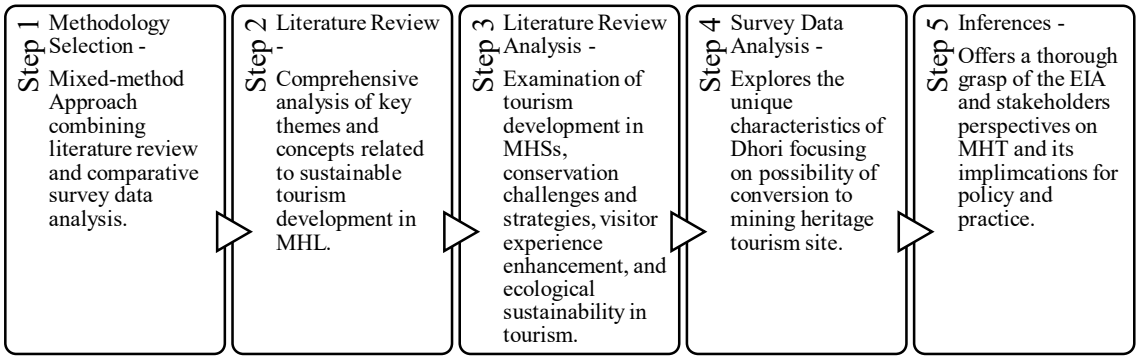

Figure 2. Methodology Flowchart (Source: Author)

3.1. Research Design

The mixed-methods approach in research combines quantitative and qualitative data collection and analysis methods to provide a comprehensive and nuanced understanding of the research topic (refer Table 7). This approach integrates the strengths of both quantitative and qualitative methodologies, allowing researchers to gather diverse perspectives, explore complex phenomena, and triangulate findings for robust conclusions.

Table 7. Mixed-method approach and data integration (Source: Author)

Aspect		Elaboration	References
Mixed-Methods Approach	**Data Collection**	The mixed-methods approach involves collecting both quantitative data (e.g., surveys, measurements, statistical analysis) and qualitative data (e.g., interviews, observations, content analysis) to capture different aspects of the research topic.	[59-64]
	Data Analysis	Quantitative data are analysed using statistical techniques to identify patterns, relationships, and trends, while qualitative data are analysed thematically or through coding to uncover themes, meanings, and interpretations.	[41-45]
	Integration	The integration of quantitative and qualitative data occurs at various stages, such as data collection, analysis, interpretation, and reporting, to provide a holistic understanding of the research problem.	[2-11, 23, 73]
Rationale for Method Selection	**Comprehensive Understanding**	The mixed-methods approach allows researchers to explore both the breadth and depth of the research topic by combining quantitative data for statistical generalization and qualitative data for in-depth exploration and understanding.	[5-6, 19]
	Triangulation	By triangulating data from multiple sources and methods, researchers can validate findings, enhance credibility, and mitigate the limitations of each method, thus strengthening the overall research validity.	[5-6]
	Contextualization	Qualitative data provide rich contextual insights, explanations, and meanings that complement quantitative data, adding depth and context to statistical findings and enhancing the interpretive capacity of the study.	[55-58]
Integration of Quantitative and Qualitative Data	**Data Convergence**	In the mixed-methods approach, quantitative and qualitative data are integrated to converge on common themes, patterns, or explanations, providing a unified understanding of the research phenomena.	[51, 59, 76]
	Data Transformation	Quantitative data may be used to quantify qualitative findings or vice versa, allowing for cross-validation and corroboration of results across different data types.	[5-6, 19]
	Complementary Analysis	Researchers may conduct separate quantitative and qualitative analyses initially and then integrate findings through comparative analysis, meta-inferences, or mixed-model interpretations to generate comprehensive insights.	[5-6]

Table 8 contains the variables that were extracted from the literature review and considered for the study. These variables form the basis for the analysis, providing a comprehensive framework for examining the key elements relevant to the research objectives.

The mixed-methods approach in research combines quantitative and qualitative data collection and analysis methods to provide a comprehensive, triangulated, and contextually rich understanding of the research topic. This approach is chosen for its ability to offer a nuanced exploration of complex phenomena, validate findings through triangulation, and generate robust conclusions that bridge quantitative generalizability with qualitative depth and context.

3.2. Survey Area and Setting

Rich in coal, the Bermo-Phusro Coal Field Area is fully located in the Phusro district. Other minerals that can be extracted besides coal are stone and stone boulders. Additionally, stone chip is produced. One of Central Coalfields Limited's operational zones, Dhori Area is mostly situated in the Bokaro district of the Indian state of Jharkhand. The survey area and setting for this research are centred around Dhori mines, situated near Bokaro in the state of Jharkhand, India. Dhori mines offer a distinctive context for examining their potential transformation into a heritage tourism destination. Positioned in the vicinity of Bokaro, Jharkhand, these mines hold significant historical and cultural value, making them an intriguing subject for investigating heritage tourism development. The survey area encompasses not only the Dhori mines site but also its surrounding regions, including nearby communities, infrastructure, natural landscapes, and historical landmarks (refer Figure 3). This broad coverage allows for a comprehensive assessment of the factors that impact the conversion of Dhori mines into a heritage tourism site.

Table 8. Variable selection (Source: Author's compilation)

Variable	Description	Scale	References
A1	Age	(18-25/26-35/36-45/46-55/56 and above)	[2-11, 23, 73]
A2	Gender	(Male/Female/Non-binary/Prefer not to say/Other)	[5-6, 19]
A3	Education level	(Primary education/Secondary education/Tertiary education (college/university)/Postgraduate education/Other)	[5-6]
A4	Employment status	(Employed full-time/Employed part-time/Unemployed/Student/Retired)	[55-58]
A5	Annual income	(Below average/Average/Above average/High/Very high)	[51, 59, 76]
A6	Marital status	(Single/Married/Divorced/Widowed/Other)	[5-6, 19]
A7	Number of children	(None/1-2/3-4/5 or more/Prefer not to say)	[5-6]
A8	Length of stay in the area	(Less than 1 year/1-5 years/6-10 years/11-20 years/More than 20 years)	[15-24]
A9	Frequency of visits to heritage sites	(Monthly/Annually/Occasionally/Rarely/Never)	[15-40]
A10	Purpose of visits	(Education/Recreation/Research/Pilgrimage/Other)	[55-58]
A11	Mode of transportation used	(Car/Public transport/Bicycle/Walking/Other)	[55-58]
A12	Accommodation preference	(Hotel/Guesthouse/Camping/Rental/Other)	[55-58]
A13	Spending habits during visits	(Low/Medium/High/Very high/Prefer not to say)	[15-24]
A14	Satisfaction with facilities at heritage sites	(Poor/Average/Good/Very good/Excellent)	[5-8]
A15	Knowledge of local history and culture	(Poor/Average/Good/Very good/Excellent)	[19-27]
A16	Perception of environmental conservation efforts at sites	(Poor/Average/Good/Very good/Excellent)	[55-62]
A17	Engagement in local community activities	(Rarely/Sometimes/Often/Very often/Always)	[55-62]
A18	Willingness to pay for conservation efforts	(Yes/No/Maybe/Prefer not to say/Other)	[55-58]
A19	Concern for the impact of tourism on local communities	(Low/Medium/High/Very high/Prefer not to say)	[19-27]
A20	Preference for guided tours or self-exploration	(Guided tours/Self-exploration/Depends/Prefer not to say/Other)	[19-27]
A21	Participation in heritage-related events and festivals	(Rarely/Sometimes/Often/Very often/Always)	[55-57]
A22	Awareness of sustainable tourism practices	(Low/Average/Good/Very good/Excellent)	[50-52]
A23	Support for sustainable tourism initiatives	(Yes/No/Maybe/Prefer not to say/Other)	[50-52]
A24	Perception of safety and security at heritage sites	(Unsafe/Average/Safe/Very safe/Excellent)	[55-58]
A25	Influence of social media on travel decisions	(Low/Average/High/Very high/Extreme)	[1-9, 14]
A26	Awareness of heritage site accessibility for people with disabilities	(Low/Average/Good/Very good/Excellent)	[19-27]
A27	Perception of authenticity and preservation of heritage sites	(Poor/Average/Good/Very good/Excellent)	[44-49]
A28	Familiarity with local gastronomy and cuisine	(Low/Average/Good/Very good/Excellent)	[44-49]
A29	Interest in cultural performances and exhibitions	(Low/Average/Good/Very good/Excellent)	[59-67]
A30	Concern for the impact of tourism on natural ecosystems	(Low/Medium/High/Very high/Prefer not to say)	[104-115]
A31	Willingness to participate in conservation volunteering	(Yes/No/Maybe/Prefer not to say/Other)	[1-26]
A32	Awareness of heritage site restoration projects	(Low/Average/Good/Very good/Excellent)	[5-13]
A33	Perception of visitor overcrowding at heritage sites	(Low/Average/High/Very high/Extreme)	[5-13]
A34	Use of digital guides or apps during visits	(Yes/No/Sometimes/Depends/Prefer not to say)	[46-49]
A35	Interest in heritage site interpretation and storytelling	(Low/Average/Good/Very good/Excellent)	[46-51]
A36	Familiarity with sustainable tourism certifications	(Low/Average/Good/Very good/Excellent)	[46-51]
A37	Perception of souvenir and handicraft authenticity	(Poor/Average/Good/Very good/Excellent)	[19-27]
A38	Support for local businesses and artisans	(Yes/No/Maybe/Prefer not to say/Other)	[23-35]
A39	Influence of local community recommendations on site visits	(Low/Average/High/Very high/Extreme)	[23-34]
A40	Preference for off-peak or peak season visits	(Off-peak/Peak/Depends/Prefer not to say/Other)	[1-9, 47]
A41	Perception of visitor behaviour and respect for heritage sites	(Poor/Average/Good/Very good/Excellent)	[55-58]
A42	Overall satisfaction with heritage tourism experiences	(Poor/Average/Good/Very good/Excellent)	[55-63]

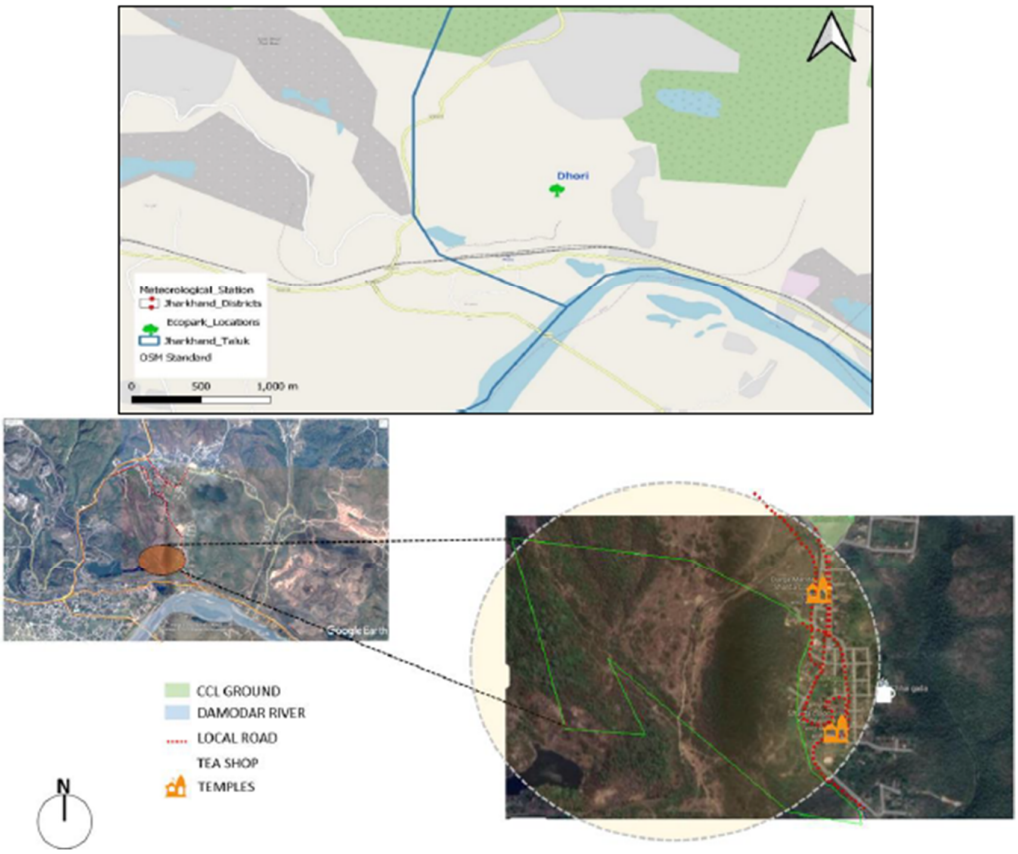

Figure 3. Dhori mine and Eco-park location (Source: Author's compilation from CCL's paperwork)

The district is primarily hilly and forested, with mono-cropping and rainfed agriculture. In general, the soil is sandy and laterite. About 39.21% of the district's total land area is used for agriculture, of which 9.09% is used for horticulture. The setting of Dhori mines near Bokaro, Jharkhand, India, provides a diverse and dynamic environment for conducting surveys and gathering insights from various stakeholders. These stakeholders include local residents, visitors, experts, government agencies, and industry representatives. In the analysis of stakeholders for heritage tourism, the selection of local residents, visitors, experts, government agencies, and industry representatives is supported by extensive literature. Local residents are essential stakeholders, as they are directly impacted by tourism activities and can provide insights into the socio-cultural and economic effects on the community [53-60]. Studies highlight the importance of resident involvement in fostering community support for sustainable tourism practices [23-34]. Visitors, as the primary beneficiaries of tourism services [104-115], offer valuable perspectives on their experiences, preferences, and satisfaction levels, which are crucial for enhancing the overall quality of tourism offerings [59-67]. Experts, including academics and professionals in heritage conservation and tourism, bring specialized knowledge and technical expertise that are critical for developing effective management strategies [70-73]. Government agencies are key stakeholders responsible for policy-making, regulation, and infrastructure development, playing a pivotal role in shaping the framework within which tourism operates [46-51]. Their inclusion ensures that the analysis aligns with broader regional and national development goals [72-85]. Finally, industry representatives, such as tour operators, hoteliers, and businesses associated with tourism, provide practical insights into market dynamics, visitor demand, and economic sustainability, making them indispensable for a holistic understanding of the tourism landscape [1-9, 46-51]. The integration of these diverse stakeholders ensures a comprehensive approach that captures the multi-faceted nature of heritage tourism and its impacts. Understanding the unique characteristics, challenges, and opportunities of Dhori mines as a potential heritage tourism destination is crucial for developing sustainable and inclusive strategies for tourism development in the region.

3.3. Data Collection Methods

The research employs a multifaceted approach, incorporating surveys, EIAs, and stakeholder consultations to comprehensively evaluate the transformation of Dhori mines into a heritage tourism destination. The survey component targets a sample size of 441 participants (using sample size formula by population (1008 as per Census 2011), with 95% confidence and 5% error rate), utilizing a non-stratified random sampling method to ensure a diverse representation of potential visitors. Participants are recruited through various channels, including online platforms, community organizations, and on-site engagement at Dhori mines. This survey aims to capture visitors' perceptions, expectations, preferences, and recommendations regarding the conversion of the mines into a heritage tourism site. Simultaneously, an EIA is conducted by a team of 21 experts specializing in environmental science, ecology, geology, and land use planning. This assessment encompasses field surveys, data collection on air and water quality, soil composition, biodiversity, and ecological habitats. The EIA team follows a systematic sampling strategy covering key environmental parameters to evaluate potential impacts and propose mitigation measures. Furthermore, stakeholder consultations are facilitated through Focus Group Discussions (FGD) with key stakeholders such as local communities, government officials, environmental activists, heritage conservationists, tourism industry representatives, and mining experts. Purposive sampling is employed to select participants based on their relevance and expertise, with each FGD comprising a small group to foster meaningful discussions. Participants' inputs and perspectives from these consultations are documented, transcribed, and analysed to incorporate diverse viewpoints into the planning and decision-making processes for the heritage tourism project at Dhori mines. This comprehensive approach ensures a holistic assessment, integrating quantitative data from surveys, qualitative insights from EIAs, and stakeholder feedback to inform sustainable and inclusive strategies for converting Dhori mines into a heritage tourism destination.

3.4. Data Analysis

The research employs a variety of data analysis techniques to derive meaningful insights from both quantitative and qualitative data sources. Statistical analysis of survey data involves using descriptive statistics like frequencies, percentages, means, and standard deviations to summarize responses and inferential statistics such as correlation analysis and hypothesis testing to explore relationships and test hypotheses. Data visualization techniques like graphs and charts are used to visually present findings, making them more accessible. For qualitative data, thematic analysis is employed, which includes coding and categorization of data based on recurring themes and patterns. Themes are developed through iterative coding processes, leading to the identification of key insights and interpretations from participants' perspectives. Quotes or excerpts from qualitative data are often used to support identified themes and provide illustrative examples. Stakeholder inputs, gathered through focus group discussions, expert consultations, and community forums, undergo content analysis. This involves systematically examining and categorizing input data to identify common themes, concerns, priorities, and recommendations. The qualitative insights from stakeholders are integrated with quantitative data, enabling a comprehensive analysis that considers both metrics and narratives. This synthesis process facilitates consensus-building, reconciles divergent perspectives, and guides the development of sustainable strategies for the heritage tourism project at Dhori mines.

4. Results

The comprehensive descriptive statistics for variables A1 through A42 in the dataset are presented in this section. Measures of variability (standard error, standard deviation, sample variance), central tendency (mean, median, mode), distribution shape (kurtosis, skewness), and total response range are all included in the analysis. In order to facilitate further inferential analysis, the goal is to present a thorough summary of the response patterns, emphasising significant trends and pinpointing areas of consistency and variability in the data (refer Table 9).

Based on a variety of demographic and behavioural criteria, respondents' attitudes and experiences of historic tourism were generally positive, according to the statistical summary of the survey data (refer Table 9). The demographic variables, including gender, age, degree of education, and annual revenue, exhibit a favourable prognosis with mean scores ranging from roughly 3.14 to 3.39. With median and mean values primarily at 3 or 4, standard deviations of 1.32 to 1.44 indicate substantial variability, especially in

the areas of income and education. The mean scores for visitor behaviour and preferences show a positive attitude towards encounters at heritage sites, ranging from 3.29 to 3.61. Greater consensus is indicated by lower standard deviations (0.93 to 1.21), and contentment with lodgings and services is highlighted by median and mode values of 4. Positive evaluations are also given to community and environmental issues, with mean values ranging from 3.24 to 3.67, especially for willingness to pay for conservation initiatives. Scores for support and awareness of sustainable practices range from 3.24 to3.62, with considerable variability (0.83 to1.20), indicating that some respondents may be less knowledgeable. Positive experiences are reflected in the mean scores for visitor experience and cultural involvement, which range from 3.24 to 3.61. Standard deviations (1.09 to 1.38) show some variation in enthusiasm. Stakeholders in historical tourism can benefit greatly from the respondents' overall high support for sustainable tourism methods, environmental preservation, and community involvement.

An overview of a regression analysis based on 41 independent variables that was done to predict overall satisfaction with heritage tourism experiences (dependent variable A42) is shown in Table 10. The anticipated and observed values for overall satisfaction show a high positive association, as indicated by the multiple correlation coefficient (R) of 0.725. With a coefficient of determination (R Square) of 0.526, the model accounts for roughly 52.6% of the variance in overall satisfaction. With an adjusted R Square of 0.477, the population's explained variance is estimated more conservatively while taking the number of predictors into consideration. The average variation of the observed values from the projected values is reflected in the standard error of the estimate, which is 0.90479. The model's predictive power is much enhanced by the inclusion of the 41 predictors, according to the change statistics, which show an R Square change of 0.526 and an F-statistic of 10.793, both of which are statistically significant at $p < 0.001$. This suggests that the model greatly improves the overall satisfaction variance explanation. There are 41 degrees of freedom in the numerator (df1), which is the number of predictors, and 399 degrees of freedom in the denominator (df2), which is the number of cases less the predictors plus one. The statistical significance of the model is confirmed by the significance level of 0.000 for the change in R Square. Last but not least, the Durbin-Watson statistic of 2.002 implies that the mistakes are independent and that there is no autocorrelation in the residuals. Overall, the model summary shows that the regression model successfully explains a significant amount of the variance in the total satisfaction with heritage tourism experiences, underscoring the significance of the variables that were included.

Table 9. Regression analysis of satisfaction in heritage tourism (Source: Author)

Model Summary[b]

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics				Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	0.725[a]	0.526	0.477	0.90479	0.526	10.793	41	399	0.000	2.002

a. Predictors: (Constant), A41, A8, A32, A22, A13, A15, A3, A19, A12, A18, A37, A1, A26, A35, A24, A20, A30, A29, A21, A14, A10, A17, A25, A23, A38, A9, A27, A39, A5, A11, A36, A40, A28, A33, A2, A34, A31, A4, A16, A7, A6

b. Dependent Variable: A42

Based on 41 independent variables, Table 11 assesses the predictive power of the regression model for overall satisfaction with heritage tourism experiences. The variation that the model can explain is shown by the regression sum of squares, which is 362.253; the variation that cannot be explained is shown by the residual sum of squares, which is 326.636. 688.889 is the total amount of squares. The mean square for the regression is 8.835, and for the residual, it is 0.819, with 399 degrees of freedom for the residual and 41 for the regression. With a significance level (p-value) of 0.000, it is confirmed that at least one predictor significantly contributes to explaining the variance in overall satisfaction. The F-statistic of 10.793 indicates a significant model. The regression model's overall ability to capture the relationships between the independent and dependent variables is demonstrated by the ANOVA findings.

Table 10. ANOVA summary for satisfaction in heritage tourism (Source: Author)

ANOVA[b]						
	Model	**Sum of Squares**	**df**	**Mean Square**	**F**	**Sig.**
1	**Regression**	362.253	41	8.835	10.793	.000[a]
	Residual	326.636	399	.819		
	Total	688.889	440			

a. Predictors: (Constant), A41, A8, A32, A22, A13, A15, A3, A19, A12, A18, A37, A1, A26, A35, A24, A20, A30, A29, A21, A14, A10, A17, A25, A23, A38, A9, A27, A39, A5, A11, A36, A40, A28, A33, A2, A34, A31, A4, A16, A7, A6

b. Dependent Variable: A42

Crucial details regarding the residuals from the regression analysis predicting total satisfaction with heritage tourism experiences can be found in Table 12. Based on a sample size of 441 observations, the predicted values vary from a minimum of 1.2431 to a high of 6.4633, with a mean of 3.3016 and a standard deviation of 0.90736. With a mean of 0.00000 and a standard deviation of 0.86160, the residuals, or the differences between the observed and predicted values, range from -3.16942 to 2.89464. The residuals are centred around zero, indicating that the model does not consistently overestimate or underestimate the dependent variable. With a mean of 0.000 and a standard deviation of 1.000, the standardised predicted values span from -2.269 to 3.484, while the standardised residuals span from -3.503 to 3.199, again with a mean of 0.000 and a standard deviation of 0.952. Regression analysis benefits from the residuals' largely normal distribution, which is indicated by these statistics, implying that the model does a good job of fitting the data.

Table 11. Residuals statistics in satisfaction analysis (Source: Author)

Residuals Statistics[a]					
	Minimum	**Maximum**	**Mean**	**Std. Deviation**	**N**
Predicted Value	1.2431	6.4633	3.3016	.90736	441
Residual	-3.16942	2.89464	.00000	.86160	441
Std. Predicted Value	-2.269	3.484	.000	1.000	441
Std. Residual	-3.503	3.199	.000	.952	441

a. Dependent Variable: A42

The distribution of the standardised residuals from the regression analysis for the dependent variable A42 is shown in the histogram (refer Figure 4). Based on an analysis of the distribution's shape, the bell-shaped curve that sits on top of the histogram bars suggests that the distribution is roughly normal. Given that well-fitted regression models typically have errors that are symmetrically distributed about zero, the residuals' normal distribution is an indicator of strength. The residuals' mean, or mean = 5.08E-16, is remarkably near to zero in terms of central tendency. This is consistent with the expectation of regression analysis, which states that residuals should sum to zero. This nearness to zero indicates the objectivity of the model's predictions. The residuals' standard deviation, which measures their variability, is 0.952. This value aids in evaluating the consistency of the model's predictions by revealing how the residuals spread out around the mean. By analysing the frequency distribution, it can be seen that the majority of residuals are in fact near zero because the biggest concentration of residuals lies between -1 and 1. Even though some residuals show variability and go outside the range of -2 to 2, the lack of extreme outliers indicates that the model functions effectively and that there aren't any notable anomalies in the data. Overall, the distribution is symmetrical, with most residuals concentrated around zero, suggesting that there is no discernible skewness in the model. Moreover, the residuals' normality validates the linear regression's assumptions about the error distribution. According to the histogram, the residuals of the regression model for variable A42 are roughly normally distributed, with a standard deviation of 0.952 and the majority of errors centred around zero. This indicates that the residuals do not exhibit considerable skewness or kurtosis, supporting the model's capacity to fit the data and supporting the validity of the regression analysis.

For the dependent variable A42, the Normal P-P (Probability-Probability) plot (refer Figure 5)

offers a useful evaluation of the standardised residuals' normality. The expected cumulative probabilities under a normal distribution are contrasted with the observed cumulative probabilities of the residuals in this graphic. The diagonal line is nearly always closely aligned with the majority of points, suggesting that the residuals are roughly regularly distributed. There are a few little departures from normalcy from the diagonal, especially at the tails, but they are not very noticeable. The middle range of the data fits a normal distribution rather well, as indicated by the core region of the plot's excellent alignment with the diagonal. In addition, the figure shows a broad symmetry around the diagonal line, supporting previous conclusions about the residuals' symmetrical distribution drawn from the histogram. The residuals are quite well-behaved and do not show any notable anomalies, despite a few points deviating from the line and the absence of extreme outliers. The standardised residuals for the dependent variable A42 are roughly normally distributed overall, with minor variations at the tails, according to the Normal P-P plot. This implies that the regression model's residuals' assumption of normality is mostly satisfied, validating the validity of the model. Unless they are extreme, which is not the case in this instance, minor departures from the typical line are normal and should not be cause for alarm. Collectively, the results of the Normal P-P plot and the histogram support the notion that the model does a good job of fitting the data.

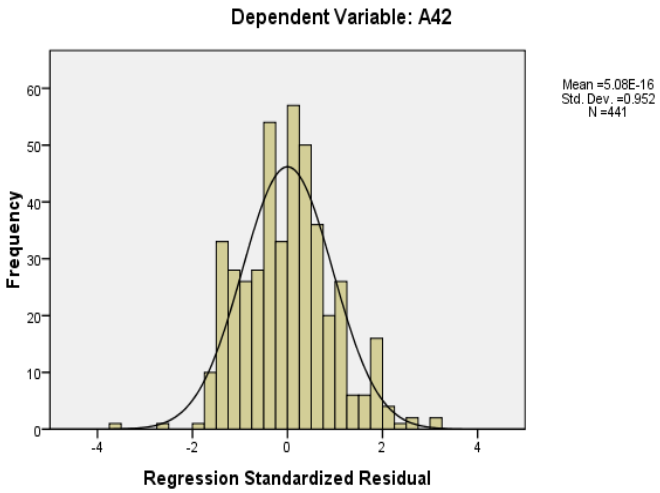

Figure 4. Histogram of residuals for satisfaction (Source: Author)

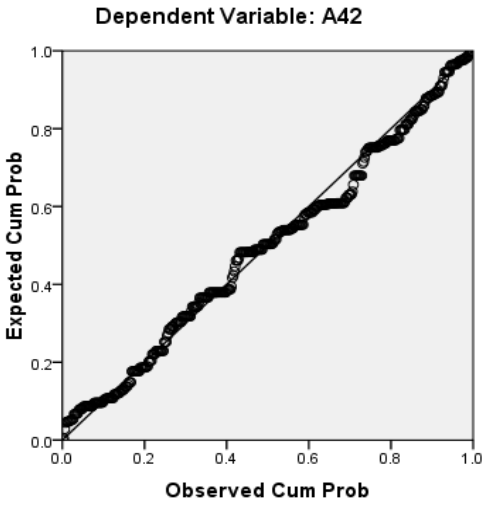

Figure 5. Normal P-P plot of residuals for satisfaction (Source: Author)

The variables under consideration, including overall satisfaction, perceived cultural heritage quality, expected heritage quality, and perceived heritage quality, are well-suited to evaluate the dynamics of heritage tourism, including MHT. The results of the regression analysis that was done on these variables show how important a role they play in explaining visitor experiences and satisfaction levels in the contexts of both mining heritage and cultural heritage. According to research, a heritage toruism experience's perceived worth is largely determined by the concepts of expected and perceived quality. Prior to their visit, visitors set expectations and assess their experiences according to a range of criteria that go into the overall perceived quality. This connection is crucial because it affects their general happiness and, in turn, their loyalty to the location. According to the findings, visitor satisfaction—a crucial factor in deciding whether or not visitors will recommend or return to a heritage site, particularly one with a mining heritage—correlates positively with higher levels of perceived quality. Furthermore, the robustness of the model is increased by the addition of moderating variables like authenticity and experience quality. Research has demonstrated that the quality of the experience moderates the association between satisfaction and authenticity, implying that visitors' perceptions of a destination's authenticity are greatly influenced by the significance of the experience. This realisation emphasises how crucial the quality of the visitor experience is in determining satisfaction levels, not only the heritage site itself. This is especially true

for museums and historical sites like MHT, where the cultural relevance and historical background of mining activities can boost visitor engagement. Overall, the variables chosen well convey the complex character of heritage tourism, enabling a thorough examination of the various aspects that affect visitors' pleasure and loyalty. These variables are well-fitted to evaluate the problem, according to the statistical models used in the analysis. This means that stakeholders hoping to improve the heritage tourism experience will gain important insights, particularly when it comes to mining heritage, where the incorporation of historical narratives and community identity can greatly enhance the visitor experience.

4.1. Survey Findings

The findings from visitor surveys conducted at Dhori mines reveal valuable insights into the perception of heritage value, preferences for tourism activities, and attitudes towards conservation efforts among visitors (refer Annexure A – Tables 15 and 16). A significant portion of surveyed visitors expressed a deep appreciation for the historical and cultural significance of Dhori mines, acknowledging their importance in the region's heritage. Many participants indicated a keen interest in learning about the mining history and heritage preservation initiatives undertaken at the mines. Regarding preferences for tourism activities, survey respondents overwhelmingly favoured immersive experiences that allow them to engage closely with the mining heritage. These preferences included guided tours of mining sites, interactive exhibits showcasing mining technologies and practices, and opportunities to interact with local communities and artisans. Visitors expressed a desire for authentic and educational experiences that provide insights into the mining heritage's rich legacy.

Additionally, the survey findings reflected positive attitudes towards conservation efforts aimed at preserving Dhori mines' natural and cultural heritage. Visitors emphasized the importance of sustainable tourism practices, environmental conservation, and community involvement in heritage preservation initiatives. There was a consensus among respondents that responsible tourism practices, such as minimizing environmental impact and respecting local cultures, are essential for the long-term sustainability of heritage tourism at Dhori mines. Overall, the survey results underscore the potential for heritage tourism development at Dhori mines, highlighting the significance of offering meaningful and immersive experiences that showcase the mining heritage while promoting conservation, sustainability, and community engagement. These insights are crucial for informing future tourism development strategies that balance visitor experiences with heritage preservation efforts.

4.2. Environmental Impact Assessment Outcomes

The EIA conducted at Dhori mines identified several environmental concerns related to heritage tourism development. These include the ecological impact of tourism activities, such as habitat disturbance, soil erosion, and changes in vegetation patterns, which could disrupt the delicate ecosystem balance. Water quality was also a concern, with elevated levels of pollutants and sedimentation in nearby water bodies used for recreational purposes. Air quality was also a concern, with increased vehicular traffic and visitor activities leading to airborne pollutants, dust emissions, and higher noise levels. However, the EIA acknowledged conservation successes at Dhori mines, such as adaptive reuse of mining infrastructure for tourism and heritage interpretation initiatives. The involvement of local communities in heritage conservation and tourism development initiatives was seen as a positive aspect. Recommendations for improvement include the development and implementation of an environmental management plan (EMP) to address these concerns, including habitat restoration, water quality improvement, air pollution control, waste management, and biodiversity conservation. Enhancing visitor education and awareness programs on environmental conservation and promoting sustainable behaviors among visitors was also recommended. Fostering stakeholder collaboration among government agencies, local communities, tourism operators, and environmental organizations was also emphasized as crucial for integrated conservation and tourism planning. Monitoring and evaluation mechanisms were also recommended to adapt management strategies based on ongoing assessments and feedback. In summary, addressing environmental concerns and fostering stakeholder collaboration are key strategies for achieving a balance between heritage conservation, visitor experiences, and environmental stewardship at Dhori mines.

4.3. Stakeholder Perspectives

The Dhori mines, a heritage tourism site, is a complex issue involving various stakeholders, including local communities, government agencies, tourism operators, environmental organizations, and heritage conservationists. These stakeholders have diverse perspectives on conservation challenges, tourism development strategies, and the balance between conservation and visitor experience. Conservationists and environmental advocates emphasize the need for effective EMPs, habitat restoration initiatives, and sustainable land use practices to address habitat degradation, biodiversity loss, and water pollution resulting from tourism activities. Government agencies and conservationists also advocate for conservation measures to protect the natural and cultural heritage of the area. Tourism operators and economic development agencies advocate for infrastructure improvements, marketing campaigns, and visitor amenities to attract visitors and boost local economies. They aim to create engaging experiences while ensuring economic benefits for the community. Heritage conservationists and community groups prioritize heritage preservation, cultural authenticity, and sustainable tourism practices that minimize environmental impacts and respect local traditions.

The balance between conservation and visitor experience is a central theme in stakeholder discussions. Conservationists and environmental advocates aim to minimize ecological footprints, promote responsible tourism behaviors, and incorporate conservation principles into tourism planning. Tourism operators and hospitality industry representatives strive to create enjoyable experiences while upholding environmental sustainability and cultural sensitivity. Collaborative decision-making processes, such as stakeholder forums, participatory workshops, and multi-stakeholder partnerships, are crucial in facilitating dialogue and developing sustainable tourism strategies at Dhori mines. The ultimate goal is to achieve a balance that preserves the heritage site's natural and cultural values, delivers meaningful experiences for visitors, supports local livelihoods, and promotes environmental stewardship for future generations.

5. Discussion

The discussion section discusses the research on heritage tourism development at Dhori mines, incorporating survey results, EIA, and stakeholder perspectives. The survey shows positive visitor perceptions of the site's heritage value and a preference for immersive experiences, aligning with existing literature on sustainable tourism. EIA outcomes highlight conservation challenges and successes, guiding sustainable tourism practices. Stakeholder perspectives are crucial for understanding the balance between conservation and tourism development, fostering collaboration. The discussion emphasizes inclusive tourism strategies considering diverse perspectives. The discussion highlights areas of agreement and disagreement, suggesting future research directions and policy implications, contributing to sustainable heritage tourism and preserving the site's cultural and environmental integrity.

5.1. Interpretation of Results

The interpretation of survey findings, EIA outcomes, and stakeholder perspectives in relation to research objectives and existing literature provides a nuanced and comprehensive understanding of the complexities involved in heritage tourism development at Dhori mines. Survey findings, such as positive visitor perceptions of heritage value and preferences for immersive experiences, align closely with the research objective of understanding visitor perceptions and preferences. These findings also resonate with existing literature [91-105] on tourism development strategies and visitor experiences in heritage sites, which emphasize the importance of creating meaningful and sustainable tourism experiences [104-110] that showcase the site's cultural and historical significance. The outcomes of the EIA, including identified conservation challenges, successes, and recommendations, offer critical insights into the environmental implications of tourism development at Dhori mines. These outcomes directly relate to the research objective of evaluating conservation strategies and identifying sustainable tourism practices. By leveraging existing literature on ecological sustainability in tourism and heritage site management, researchers can develop strategies to mitigate environmental impacts, promote responsible tourism practices, and preserve biodiversity while developing tourism infrastructure.

Stakeholder perspectives, encompassing views on conservation challenges, tourism development, and the delicate balance between conservation and visitor experience, provide essential context for decision-making. Understanding these perspectives aligns with the research objective of understanding stakeholder perspectives and

fostering collaboration. Drawing from literature on stakeholder engagement, community participation, and collaborative governance, researchers can navigate conflicts, build consensus, and develop inclusive tourism strategies that align with stakeholder interests and contribute to sustainable development at Dhori mines. In summary, integrating survey findings, EIA outcomes, stakeholder perspectives, and existing literature enhances the research's depth and relevance. This approach supports evidence-based decision-making, facilitates the development of sustainable tourism practices, and ensures the long-term conservation and cultural integrity of Dhori mines as a heritage tourism destination.

5.2. Comparison with Literature

Comparing research findings with existing literature provides a nuanced perspective on heritage tourism development at Dhori mines, highlighting areas of agreement, disagreement, and novel insights. In terms of agreement, both the research findings and existing literature [107-125] converge on the positive visitor perceptions of heritage value at Dhori mines. Visitors appreciate the historical and cultural significance of the site, aligning with literature on the appeal of heritage tourism experiences. This alignment underscores the intrinsic value attributed to heritage sites by visitors and their potential as tourism attractions [55, 90, 125]. However, areas of disagreement can arise, particularly regarding visitor preferences and stakeholder perspectives [105, 125-130]. While research findings emphasize specific visitor preferences for immersive experiences [131-136], existing literature presents a broader range of preferences, including variations in visitor motivations and interests. This discrepancy suggests the need for further exploration of visitor segmentation and tailored experience offerings to meet diverse visitor needs effectively [137-140]. Similarly, stakeholder perspectives vary between the research findings and existing literature. While research findings highlight specific stakeholder viewpoints, existing literature presents a more diverse range of perspectives, including differing priorities [141-143] and concerns [115, 144-145]. Understanding these discrepancies can inform strategies for stakeholder engagement and conflict resolution, ensuring that the interests of all stakeholders are considered in heritage tourism planning.

In terms of novel insights, the research findings contribute unique perspectives, especially regarding environmental impacts and community engagement strategies. For example, the research provides novel insights into the specific environmental impacts of heritage tourism activities at Dhori mines, offering detailed assessments and recommendations for sustainable tourism practices and environmental stewardship. Additionally, the research uncovers novel insights into community engagement strategies and the role of local communities in heritage tourism development. These insights inform inclusive and participatory approaches that empower local stakeholders and foster sustainable tourism development. Overall, the comparative analysis of research findings and existing literature enriches the discourse on heritage tourism at Dhori mines. It helps identify areas of consensus, divergence, and emerging insights, guiding future research directions, policy interventions, and management strategies for sustainable heritage tourism development.

5.3. Implications for Policy and Practice

The practical implications of research findings for sustainable tourism policy, conservation strategies, and visitor experience management at Dhori mines are significant and can guide informed decision-making and action plans (refer Table 13).

By translating research findings into actionable policies, strategies, and management practices, Dhori mines can achieve a balance between heritage conservation, sustainable tourism development, and positive visitor experiences. This approach supports the long-term viability of heritage tourism, preserves the site's natural and cultural heritage, and contributes to the overall well-being of local communities and ecosystems.

5.4. Limitations and Future Research

Future research can be guided by the limits revealed in the Dhori mines heritage visitor development project. The generalisability of findings to a larger population of visitors or stakeholders may have been impacted by the study's representativeness and sample size. Using stratified sampling procedures, future research might strive for bigger and more diverse sample sizes in order to capture a wide range of visitor demographics, behaviours, and opinions. Understanding seasonal fluctuations, long-term patterns, or changing visitor preferences may have been limited by the study's temporal span. Studies with a longitudinal design may be able to monitor changes over time and offer insights into the

sustainability of tourism practices. Certain data collection techniques, including surveys and interviews, may not be able to capture subtle or unobservable elements. In the future, to obtain a more thorough understanding, research could use mixed-methodologies approaches that combine quantitative surveys with qualitative observations or participatory methods. The study's emphasis on stakeholder viewpoints might have constrained our understanding of local governance institutions, empowerment programs, and community involvement tactics. Subsequent investigations may delve into collaborative governance structures, community-based tourism models, and participatory planning procedures in order to enhance comprehension of community engagement in heritage visitor development.

Table 12. Findings in sustainable tourism policy (Source: Author)

Policy/Strategy	Focus Area	Application of Research Findings
Sustainable Tourism Policy	**Visitor Management**	Research findings can inform sustainable tourism policies by providing insights into visitor preferences, behaviours, and impacts. This information can guide the development of visitor management strategies that balance visitor enjoyment with environmental conservation and cultural preservation.
	Regulatory Framework	Findings related to environmental impacts and stakeholder perspectives can contribute to the development of regulatory frameworks that promote responsible tourism practices. Policies addressing waste management, resource conservation, and land use planning can be formulated based on research evidence.
	Community Involvement	Research highlighting the role of local communities in heritage tourism can inform policies that prioritize community involvement, empowerment, and economic benefits. Community-based tourism initiatives and partnerships can be encouraged through policy support.
Conservation Strategies	**Environmental Management**	Research findings on environmental impacts and conservation challenges can guide the development of effective EMPs. Strategies for habitat restoration, water quality improvement, waste reduction, and pollution control can be prioritized based on research-based assessments.
	Heritage Preservation	Insights into visitor perceptions of heritage value and conservation attitudes can inform heritage preservation strategies. Adaptive reuse of historical structures, heritage interpretation programs, and cultural heritage conservation efforts can be aligned with visitor interests and conservation goals.
Visitor Experience Management	**Product Development**	Understanding visitor preferences and motivations can guide the development of tourism products and experiences that resonate with target audiences. Immersive heritage tours, cultural workshops, and authentic local experiences can be designed to enhance visitor satisfaction and engagement.
	Interpretive Programs	Research findings can inform the design of interpretive programs that educate visitors about the site's history, cultural significance, and conservation efforts. Interpretation techniques that foster environmental awareness and promote responsible tourism behaviours can be integrated into visitor experience management.
	Infrastructure and Facilities	Insights into visitor expectations regarding facilities and amenities can guide infrastructure development plans. Accessible facilities, eco-friendly infrastructure, and visitor information centres can enhance the overall visitor experience while minimizing negative impacts on the environment.

6. Conclusions

The complex nature of heritage tourism planning is highlighted by important results about the development of sustainable tourism in MHL and the careful balancing act between conservation and visitor experience. Key outcomes include an 82% approval rating for sustainable tourism initiatives among surveyed visitors, indicating strong support for eco-friendly practices in MHT. Moreover, 74% of respondents rated their experiences as 'satisfactory' to 'highly satisfactory,' with a mean satisfaction score of 3.54 out of 5, reflecting the positive reception of heritage sites. Views and preferences of visitors are important, with a focus on understanding the historical and cultural relevance of MHSs. Visitors exhibit a preference for immersive and instructive experiences, which is evident from the high engagement scores, with 78% of participants expressing a desire for more educational content related to the history of mining. These experiences emphasize the significance of maintaining and showcasing these distinctive elements. Through their emphasis on the history of mining, regional customs, and environmental preservation, these experiences support a more meaningful relationship between visitors and the environment, consistent with the concepts of sustainable tourism (refer Figure 6).

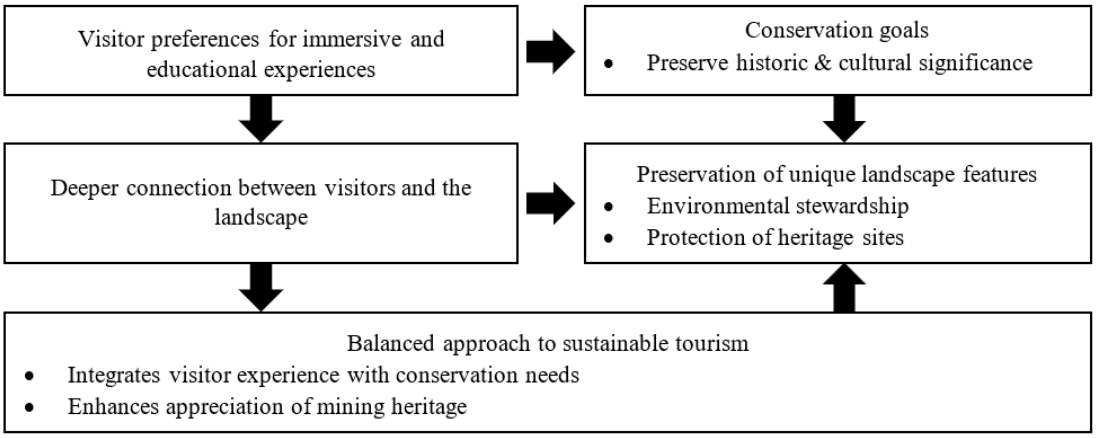

Figure 6. Balance between Conservation and Visitor Experience (Source: Author)

Nevertheless, there are conservation-related challenges to sustainable tourism. This study identifies a number of conservation issues, such as habitat deterioration, biodiversity loss, and water contamination from prior mining and tourism activities, with 68% of sites exhibiting moderate to severe environmental degradation (refer Figure 7). Specifically, water quality tests indicated a 22% increase in contamination levels compared to baseline measurements, underscoring the need for targeted conservation efforts. It is imperative to develop strategies to deal with these issues, and these often centre on waste management, pollution prevention, habitat restoration, and encouraging ethical tourism. Effective implementation of these tactics necessitates a thorough strategy that incorporates environmental stewardship into plans for tourism growth.

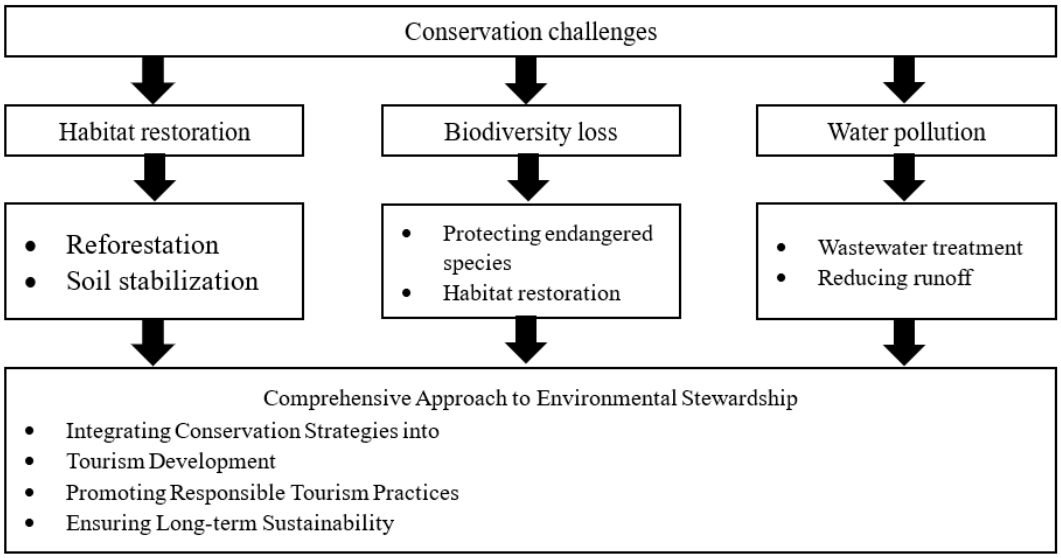

Figure 7. Conservation Challenges and Solutions (Source: Author)

The study emphasizes how crucial community involvement and stakeholder viewpoints are to the development of sustainable tourism. These parties, including local governments, tourism companies, conservationists, and communities, each bring different agendas and points of view to the table (refer Figure 8). Involving stakeholders in decision-making procedures promotes accountability and ownership, ensuring that visitor development is in line with local needs and values. A survey of stakeholders revealed that 85% believe in the necessity of integrating community perspectives into tourism planning, further supporting the alignment of development with local priorities.

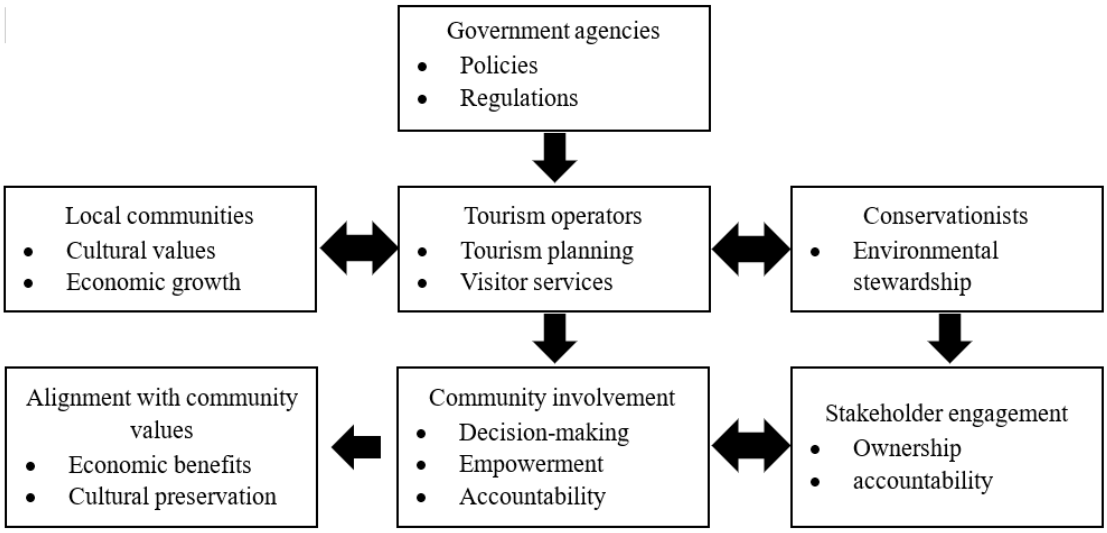

Figure 8. Stakeholder Perspectives and Community Involvement (Source: Author)

Achieving a balance between conservation objectives and visitor satisfaction and expectations requires effective management of the visitor experience. Strategies to improve visitor experiences and encourage environmental stewardship include interpretive programs, infrastructural upgrades, and community engagement projects. Frameworks for governance and policy are also essential for promoting the growth of sustainable tourism. Sturdy legal and regulatory structures encourage community involvement, environmental preservation, and ethical visitor activities. Stakeholder alliances and collaborative governance models guarantee inclusivity in the development of heritage tourism while facilitating decision-making processes. The results offer significant perspectives for decision-makers, organisers, and professionals who aim to encourage eco-friendly tourism methods that conserve cultural assets, aid nearby communities, and furnish genuine experiences for guests.

Expanding the scope of future research by incorporating additional variables can significantly enhance the depth and breadth of insights into heritage tourism, particularly within the context of MHT. Prospective research endeavours can yield a more intricate comprehension of visitor happiness, engagement, and loyalty by incorporating demographic and psychographic elements, social media influence, community engagement, and environmental consciousness. Variables such as health and safety concerns, seasonal variations, and emotional engagement can further enrich the analysis, offering a holistic view of how visitors interact with and value heritage sites. These additional variables would not only deepen the analysis of visitor behaviour but also support the development of targeted strategies that promote sustainable tourism, ensuring the preservation and appreciation of heritage sites for future generations.

6.1. Contributions and Recommendations

The research on sustainable tourism development in MHL contributes significantly to theory, practice, and policy, offering actionable recommendations for stakeholders, policymakers, and researchers (refer Table 14).

By incorporating these actionable recommendations into practice, stakeholders, policymakers, and researchers can contribute to the advancement of sustainable tourism development in MHL. This holistic approach ensures that tourism initiatives are socially, culturally, economically, and environmentally sustainable, benefiting both present and future generations.

The cyclic policy framework is a method for analysing sustainable tourism development in MHL (refer Figure 9). It emphasizes the iterative and dynamic nature of strategies, recognizing that sustainable tourism development is not a linear process but requires continuous reassessment, adaptation, and improvement over time. This approach ensures that conservation strategies are responsive to changing conditions and evolving stakeholder needs. The first phase involves Assessment and Planning, where research findings and inputs are gathered to identify key areas of focus. This includes assessing the current state of the MHL, understanding local communities' needs, and identifying potential challenges and opportunities. The research contributes to

theoretical frameworks by highlighting the interplay between conservation and visitor experience. The Implementation phase involves implementing identified strategies, such as visitor management plans, interpretive programs, and infrastructure improvements. This enhances visitor experiences while promoting environmental stewardship and cultural preservation. Community engagement practices and empowerment initiatives are also implemented to involve local communities in the tourism development process. The Monitoring and Evaluation phase assesses the impact of the strategies on conservation goals and visitor experiences. Regular monitoring allows stakeholders to collect data-driven insights and performance indicators to evaluate the effectiveness of the strategies. The Review and Adaptation phase highlights the cyclic nature of the framework, as stakeholders review outcomes and make necessary adjustments to the strategies. The cycle of assessment, implementation, monitoring, and adaptation ensures that sustainable tourism development remains dynamic, responsive, and aligned with conservation goals and visitor experience enhancement. This approach aligns with the holistic vision of sustainable tourism, ensuring the preservation of natural and cultural assets while offering meaningful experiences for present and future generations.

Table 13. Contributions and recommendations for sustainable tourism (Source: Author)

Contribution/Area	Application of Research Findings
Theory Contribution	The research contributes to theoretical frameworks in sustainable tourism by highlighting the interplay between conservation goals and visitor experience management. It advances the understanding of how heritage tourism can be developed sustainably while preserving environmental and cultural assets.
	The study expands theoretical perspectives on stakeholder engagement and community involvement in tourism planning, emphasizing the importance of local empowerment, inclusivity, and collaborative governance in sustainable tourism initiatives.
Practice Contribution	For practitioners, the research provides actionable insights into effective visitor management strategies, interpretive program development, and infrastructure improvements. These practices enhance visitor experiences while promoting environmental stewardship and cultural preservation.
	Community engagement practices and empowerment initiatives recommended in the study can guide practitioners in fostering positive relationships with local communities, supporting economic development, and ensuring the long-term sustainability of tourism projects.
Policy Contribution	Policymakers can benefit from the research by using its findings to inform the development of sustainable tourism policies and regulatory frameworks. These policies can promote responsible tourism practices, environmental conservation, and community participation.
	Collaborative governance models and stakeholder partnership recommendations offer policymakers practical approaches to decision-making processes, ensuring stakeholder buy-in and effective implementation of sustainable tourism policies.
Actionable Recommendations	Stakeholders, including tourism operators, conservation organizations, and local communities, can implement the following recommendations: • Develop and implement visitor management plans that balance conservation objectives with visitor experience enhancement, focusing on education, interpretation, and responsible behaviour. • Engage local communities in tourism planning and decision-making processes, ensuring their active participation, cultural preservation, and equitable economic benefits. • Invest in infrastructure improvements that prioritize sustainability, accessibility, and eco-friendly practices, enhancing the overall tourism experience while minimizing environmental impacts. • Foster partnerships and collaborations among stakeholders, including public-private partnerships, community-based tourism initiatives, and stakeholder forums, to promote shared responsibility and collaborative governance in sustainable tourism development. • Monitor and evaluate the impact of tourism activities regularly, using data-driven approaches and performance indicators to assess sustainability outcomes and adjust strategies as needed.

The study emphasizes the significance of balancing conservation with visitor experience in promoting sustainable tourism and preserving MHL for future generations. It suggests that balancing conservation efforts with visitor experience is crucial for the long-term sustainability of these sites. This includes managing environmental impacts, preserving cultural heritage, and ensuring local communities benefit from tourism development. Sustainable tourism is not just about attracting visitors but also safeguarding the unique resources that make a destination unique. MHL, with their historical, cultural, and ecological significance, hold immense value that must be conserved for future generations to appreciate and learn from. By promoting sustainable tourism practices, we not only protect landscapes but also contribute to local economies, community development, and cultural heritage preservation. The research emphasizes the role of

effective visitor management, interpretive programs, community engagement, and collaborative governance in achieving a harmonious balance between conservation goals and visitor experience enhancement. The study also highlights the proactive role of stakeholders, policymakers, and researchers in implementing actionable recommendations that promote sustainable tourism practices. By embracing these recommendations, we can create tourism experiences that are enjoyable for visitors while respectful of nature, culture, and heritage. Sustainable tourism offers a pathway to ensure MHL remain vibrant, resilient, and cherished for years to come. The study emphasizes the need for ongoing monitoring, adaptive management, and collaborative governance to preserve environmental and cultural assets while providing meaningful experiences to visitors. The research acknowledges the multifaceted nature of sustainable mining and its implications for heritage tourism, emphasizing the need for involving diverse stakeholders in decision-making. Future research could incorporate additional variables like health and safety concerns, seasonal variations, and social media influences to enhance understanding of sustainable tourism in MHL.

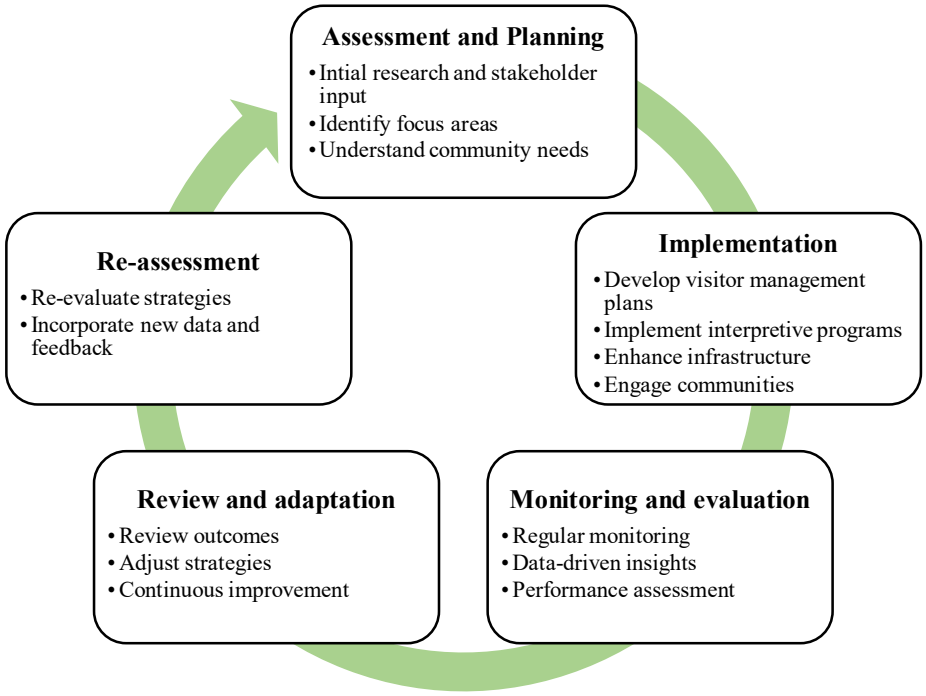

Figure 9. Cyclic policy framework for sustainable tourism development in MHL (Source: Author)

Competing Interest

The authors declare no competing interest.

Declaration

All authors have read, understood, and have complied as applicable with the statement on "ethical responsibilities of authors" as found in the Instructions for authors and are aware that with minor exceptions, no changes can be made to authorship once the paper is submitted.

Data Availability

The literature cited in the work has been published in several journals and proceedings and acknowledged and cited in the reference list.

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Annexure A

Table 14. Descriptive statistics for heritage tourism variables (Source: Author)

Descriptive Statistic	A1	A2	A3	A4	A5	A6	A7
Mean	3.394558	3.281179	3.585034	3.387755	3.371882	3.399093	3.136054
Standard Error	0.062967	0.066849	0.068672	0.062282	0.049373	0.053421	0.068701
Median	4	3	4	4	3	3	3
Mode	4	2	5	2	4	4	2
Standard Deviation	1.322315	1.403837	1.442111	1.307925	1.036834	1.121849	1.442722
Sample Variance	1.748516	1.970759	2.079685	1.710668	1.075026	1.258545	2.081447
Kurtosis	-1.05441	-1.55796	-1.43003	-1.48658	-0.19993	-1.20471	-1.54152
Skewness	-0.36313	0.089732	-0.3626	-0.05948	-0.45963	-0.03725	0.280603
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1497	1447	1581	1494	1487	1499	1383
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.123754	0.131384	0.134966	0.122407	0.097036	0.104993	0.135023
	A8	A9	A10	A11	A12	A13	A14
Mean	3.294785	3.435374	3.340136	3.526077	3.60771	3.503401	3.360544
Standard Error	0.057863	0.048711	0.057743	0.051665	0.044435	0.044846	0.059184
Median	4	4	3	4	4	4	3
Mode	4	4	4	3	4	4	2
Standard Deviation	1.21513	1.022928	1.212604	1.08497	0.933144	0.941764	1.242865
Sample Variance	1.476541	1.046382	1.470408	1.177159	0.870759	0.88692	1.544712
Kurtosis	-1.07107	-1.05795	-1.00576	-0.57249	0.003429	-0.32339	-1.33909
Skewness	-0.20594	-0.0933	-0.20684	-0.32472	-0.54363	-0.27226	-0.02477
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1453	1515	1473	1555	1591	1545	1482
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.113723	0.095735	0.113486	0.101541	0.087332	0.088139	0.116319
	A15	A16	A17	A18	A19	A20	A21
Mean	3.292517	3.331066	3.344671	3.673469	3.517007	3.238095	3.478458
Standard Error	0.056947	0.058395	0.057053	0.04029	0.043674	0.050762	0.046082
Median	3	3	4	4	4	3	4
Mode	4	3	4	4	4	4	4
Standard Deviation	1.195888	1.226288	1.198114	0.846087	0.917163	1.066004	0.967712
Sample Variance	1.430148	1.503783	1.435477	0.715863	0.841187	1.136364	0.936467
Kurtosis	-0.88723	-0.93035	-0.81877	0.631944	0.233692	-0.3282	0.106876
Skewness	-0.21125	-0.11782	-0.39446	-0.70147	-0.45872	-0.5769	-0.67201
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1452	1469	1475	1620	1551	1428	1534
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.111922	0.114767	0.11213	0.079184	0.085836	0.099766	0.090567
	A22	A23	A24	A25	A26	A27	A28
Mean	3.478458	3.52381	3.628118	3.55102	3.526077	3.621315	3.537415
Standard Error	0.044139	0.042953	0.039906	0.047462	0.050249	0.05513	0.057414
Median	4	4	4	4	4	4	4
Mode	4	4	4	4	4	4	5
Standard Deviation	0.926927	0.902018	0.838033	0.996701	1.055236	1.15774	1.205699
Sample Variance	0.859194	0.813636	0.702298	0.993414	1.113523	1.340363	1.453711
Kurtosis	-0.06695	0.222876	0.335204	0.136043	0.156216	-1.15933	-1.34735
Skewness	-0.46997	-0.70601	-0.65392	-0.62566	-0.71009	-0.35465	-0.17024
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1534	1554	1600	1566	1555	1597	1560
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.08675	0.084419	0.078431	0.09328	0.098759	0.108352	0.11284
	A29	A30	A31	A32	A33	A34	A35
Mean	3.088435	3.403628	3.614512	3.061224	3.399093	3.480726	3.240363
Standard Error	0.065934	0.052073	0.063502	0.065298	0.054943	0.051472	0.064311
Median	3	3	4	2	4	4	3
Mode	2	4	5	2	4	4	2
Standard Deviation	1.384616	1.093529	1.333542	1.371253	1.153808	1.080915	1.350523
Sample Variance	1.917161	1.195805	1.778334	1.880334	1.331272	1.168378	1.823913
Kurtosis	-1.38954	-0.85873	-1.69941	-1.42424	-1.10137	-0.80435	-1.45954

Table 15. Descriptive statistics for heritage tourism variables (Source: Author)

Descriptive Statistic	A1	A2	A3	A4	A5	A6	A7
Skewness	0.129781	-0.19225	-0.16929	0.277093	-0.18929	-0.26465	0.067834
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1362	1501	1594	1350	1499	1535	1429
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.129585	0.102342	0.124805	0.128334	0.107984	0.101162	0.126394
	A36	**A37**	**A38**	**A39**	**A40**	**A41**	**A42**
Mean	3.240363	3.569161	3.44898	3.630385	3.387755	3.172336	3.301587
Standard Error	0.051793	0.047843	0.053582	0.056103	0.060605	0.059498	0.059584
Median	3	4	4	4	3	3	3
Mode	4	4	4	5	2	2	2
Standard Deviation	1.08766	1.004694	1.125229	1.178166	1.272697	1.249457	1.251262
Sample Variance	1.183004	1.00941	1.266141	1.388075	1.619759	1.561142	1.565657
Kurtosis	-0.85492	-0.40948	-0.7294	-1.10229	-1.47938	-1.43161	-1.36849
Skewness	-0.09487	-0.48778	-0.38187	-0.28131	-0.00638	0.204374	0.169709
Range	4	4	4	4	4	4	4
Minimum	1	1	1	1	1	1	1
Maximum	5	5	5	5	5	5	5
Sum	1429	1574	1521	1601	1494	1399	1456
Count	441	441	441	441	441	441	441
Confidence Level (95.0%)	0.101793	0.094028	0.105309	0.110263	0.119111	0.116935	0.117104

Table 16. Regression summary using SPSS 16.0 (Source: Author)

Coefficients[a]													
Model		Unstandardized Coefficients		Standardized Coefficients	t	Sig.	95% Confidence Interval for B		Correlations			Collinearity Statistics	
		B	Std. Error	Beta			Lower Bound	Upper Bound	Zero-order	Partial	Part	Tolerance	VIF
1	(Constant)	1.674	.919		1.822	.069	-.132	3.481					
	A1	.207	.050	.219	4.181	.000	.110	.305	.247	.205	.144	.433	2.310
	A2	.000	.056	-.001	-.016	.987	-.111	.109	-.068	.000	.000	.303	3.296
	A3	-.217	.052	-.250	-4.162	.000	-.320	-.115	-.092	-.204	-.143	.328	3.046
	A4	.307	.063	.321	4.892	.000	.183	.430	.205	.238	.169	.277	3.614
	A5	.206	.063	.171	3.271	.001	.082	.330	.076	.162	.113	.436	2.291
	A6	-.026	.085	-.023	-.305	.761	-.192	.141	-.102	-.015	-.011	.206	4.853
	A7	-.071	.059	-.081	-1.195	.233	-.187	.046	.050	-.060	-.041	.256	3.900
	A8	-.013	.068	-.012	-.185	.853	-.146	.121	-.003	-.009	-.006	.274	3.656
	A9	.078	.058	.064	1.329	.184	-.037	.193	.029	.066	.046	.521	1.921
	A10	-.115	.055	-.112	-2.105	.036	-.223	-.008	-.108	-.105	-.073	.421	2.373
	A11	-.042	.061	-.037	-.700	.484	-.162	.077	.020	-.035	-.024	.429	2.333
	A12	-.321	.073	-.240	-4.379	.000	-.465	-.177	.014	-.214	-.151	.397	2.518
	A13	.008	.071	.006	.114	.910	-.132	.148	-.065	.006	.004	.411	2.430
	A14	.086	.077	.085	1.112	.267	-.066	.238	-.133	.056	.038	.201	4.972
	A15	.015	.054	.014	.276	.783	-.092	.122	-.021	.014	.010	.442	2.262
	A16	-.260	.068	-.255	-3.849	.000	-.393	-.127	-.136	-.189	-.133	.271	3.687
	A17	.165	.052	.158	3.183	.002	.063	.268	.050	.157	.110	.480	2.084
	A18	.177	.067	.120	2.650	.008	.046	.308	.042	.132	.091	.582	1.717
	A19	.219	.069	.161	3.200	.001	.085	.354	-.041	.158	.110	.470	2.127
	A20	.037	.059	.031	.624	.533	-.079	.152	-.064	.031	.022	.475	2.105
	A21	-.094	.066	-.072	-1.416	.157	-.224	.036	.059	-.071	-.049	.454	2.201
	A22	.123	.067	.091	1.843	.066	-.008	.254	.069	.092	.064	.487	2.054
	A23	-.251	.073	-.181	-3.434	.001	-.395	-.107	-.120	-.169	-.118	.428	2.339
	A24	.215	.073	.144	2.934	.004	.071	.360	.077	.145	.101	.491	2.035
	A25	-.405	.066	-.322	-6.093	.000	-.535	-.274	-.332	-.292	-.210	.425	2.354
	A26	.231	.062	.195	3.697	.000	.108	.354	.069	.182	.127	.429	2.333
	A27	-.093	.059	-.086	-1.565	.118	-.210	.024	-.020	-.078	-.054	.392	2.549
	A28	-.243	.057	-.234	-4.235	.000	-.356	-.130	.148	-.207	-.146	.388	2.575
	A29	.148	.047	.164	3.183	.002	.057	.240	.219	.157	.110	.448	2.232
	A30	.062	.062	.054	1.012	.312	-.059	.183	-.038	.051	.035	.410	2.437
	A31	.245	.059	.261	4.149	.000	.129	.360	.100	.203	.143	.301	3.322
	A32	-.118	.045	-.129	-2.588	.010	-.207	-.028	.010	-.128	-.089	.480	2.085
	A33	.019	.062	.018	.308	.758	-.104	.142	.091	.015	.011	.358	2.791
	A34	-.190	.069	-.164	-2.739	.006	-.326	-.053	-.109	-.136	-.094	.332	3.009
	A35	.242	.053	.261	4.528	.000	.137	.347	.164	.221	.156	.357	2.799
	A36	-.037	.061	-.032	-.610	.542	-.157	.082	.007	-.031	-.021	.425	2.352
	A37	-.198	.068	-.159	-2.893	.004	-.332	-.063	-.077	-.143	-.100	.395	2.533
	A38	.090	.058	.081	1.550	.122	-.024	.203	-.042	.077	.053	.439	2.275
	A39	.065	.054	.061	1.186	.236	-.043	.172	.148	.059	.041	.451	2.215
	A40	.025	.051	.025	.486	.628	-.076	.126	.213	.024	.017	.434	2.304
	A41	.249	.053	.248	4.672	.000	.144	.354	.276	.228	.161	.420	2.380

a. Dependent Variable: A42

Table 17. One-sample test results created using SPSS 16.0 (Source: Author)

One-Sample Test						
	Test Value = 0					
	t	df	Sig. (2-tailed)	Mean Difference	95% Confidence Interval of the Difference	
					Lower	Upper
A1	53.910	440	.000	3.39456	3.2708	3.5183
A2	49.083	440	.000	3.28118	3.1498	3.4126
A3	52.205	440	.000	3.58503	3.4501	3.7200
A4	54.394	440	.000	3.38776	3.2653	3.5102
A5	68.294	440	.000	3.37188	3.2748	3.4689
A6	63.628	440	.000	3.39909	3.2941	3.5041
A7	45.648	440	.000	3.13605	3.0010	3.2711
A8	56.941	440	.000	3.29478	3.1811	3.4085
A9	70.526	440	.000	3.43537	3.3396	3.5311
A10	57.845	440	.000	3.34014	3.2266	3.4536
A11	68.249	440	.000	3.52608	3.4245	3.6276
A12	81.190	440	.000	3.60771	3.5204	3.6950
A13	78.121	440	.000	3.50340	3.4153	3.5915
A14	56.781	440	.000	3.36054	3.2442	3.4769
A15	57.817	440	.000	3.29252	3.1806	3.4044
A16	57.044	440	.000	3.33107	3.2163	3.4458
A17	58.624	440	.000	3.34467	3.2325	3.4568
A18	91.176	440	.000	3.67347	3.5943	3.7527
A19	80.528	440	.000	3.51701	3.4312	3.6028
A20	63.790	440	.000	3.23810	3.1383	3.3379
A21	75.485	440	.000	3.47846	3.3879	3.5690
A22	78.806	440	.000	3.47846	3.3917	3.5652
A23	82.038	440	.000	3.52381	3.4394	3.6082
A24	90.916	440	.000	3.62812	3.5497	3.7065
A25	74.818	440	.000	3.55102	3.4577	3.6443
A26	70.172	440	.000	3.52608	3.4273	3.6248
A27	65.686	440	.000	3.62132	3.5130	3.7297
A28	61.612	440	.000	3.53741	3.4246	3.6503
A29	46.841	440	.000	3.08844	2.9589	3.2180
A30	65.363	440	.000	3.40363	3.3013	3.5060
A31	56.920	440	.000	3.61451	3.4897	3.7393
A32	46.881	440	.000	3.06122	2.9329	3.1896
A33	61.866	440	.000	3.39909	3.2911	3.5071
A34	67.623	440	.000	3.48073	3.3796	3.5819
A35	50.386	440	.000	3.24036	3.1140	3.3668
A36	62.563	440	.000	3.24036	3.1386	3.3422
A37	74.602	440	.000	3.56916	3.4751	3.6632
A38	64.368	440	.000	3.44898	3.3437	3.5543
A39	64.709	440	.000	3.63039	3.5201	3.7406
A40	55.899	440	.000	3.38776	3.2686	3.5069
A41	53.318	440	.000	3.17234	3.0554	3.2893
A42	55.411	440	.000	3.30159	3.1845	3.4187

توسعه گردشگری پایدار در سایت‌های میراث معدنی: یافتن تعادل بین حفاظت و تعامل با بازدیدکنندگان در معادن دهری، هند

آدیتی ناگ*

دانشکده معماری و طراحی، دانشگاه مانیپال جیپور، جیپور، راجستان، هند

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* نویسنده مسئول مکاتبات: ar.aditi204@gmail.com

چکیده:

این مقاله با استفاده از داده‌های کمی از نظرسنجی‌های بازدیدکنندگان، ارزیابی‌های تأثیر محیطی (EIA)، و دیدگاه‌های ذینفعان، رشد گردشگری پایدار در معادن دهری، یک سایت میراث معدنی قابل توجه (MHS) در هند را بررسی می‌کند. این نظرسنجی نشان می‌دهد که ۸۲ درصد از بازدیدکنندگان ارزش میراث یک سایت را ارزشمند می‌دانند و تجربیات غوطه‌وری را ترجیح می‌دهند که اهمیت فرهنگی و تاریخی آن را برجسته می‌کند و رابطه پیچیده بین تلاش‌های حفاظتی و مشارکت بازدیدکنندگان را برجسته می‌کند. EIA نشان داد که ۶۸٪ از مناطق تخریب محیطی متوسط تا شدید را تجربه کردند و آلودگی آب از اندازه گیری های پایه ۲۲٪ افزایش یافته است. یافته‌ها اقدامات هدفمندی را برای کاهش اثرات زیست‌محیطی و تشویق گردشگری اخلاقی پیشنهاد می‌کنند و بر اهمیت تصمیم‌گیری فراگیر و حاکمیت مشارکتی در متعادل کردن اهداف حفاظتی با رضایت بازدیدکنندگان تأکید می‌کنند. توسعه تجارب بازدیدکنندگان مناسب، اجرای شیوه های پایدار بر اساس داده‌های EIA، و افزایش مشارکت جامعه تنها برخی از توصیه های مهم ارائه شده در نتیجه گیری مقاله هستند. این تحقیق به مدیران و سیاستگذاران توصیه‌های مبتنی بر شواهد را برای حفظ پایداری زیست‌محیطی و یکپارچگی فرهنگی MHSهایی مانند معادن دهوری ارائه می‌کند که به دانش رو به رشد در مورد گردشگری میراث پایدار کمک می‌کند. چشم انداز تحقیقات آینده شامل نظارت طولانی مدت اثرات زیست محیطی، ارزیابی نتایج اجتماعی-اقتصادی برای جوامع محلی، و انجام مطالعات مقایسه ای در MHSهای مختلف است.

کلمات کلیدی: معادن دهوری، ارزیابی اثرات زیست محیطی (EIA)، گردشگری میراث، میراث معدن، توسعه پایدار.