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HERITAGE BENEATH THE SURFACE: INITIATING CAVE TOURISM IN PAKISTAN INSPIRED BY SAUDI SUCCESS STORIES

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Abstract

Pakistan possesses an extraordinary yet underutilized wealth of natural and cultural cave heritage, including prehistoric habitation sites, Buddhist meditation caves, geological formations, and sacred landscapes that collectively represent thousands of years of human history. Despite their archaeological, ecological, and tourism significance, these cave resources remain inadequately documented, poorly interpreted, and largely absent from national tourism development strategies. This study examines the potential for sustainable cave tourism in Pakistan by drawing lessons from Saudi Arabia's successful integration of geological and cultural heritage into national tourism initiatives under Vision 2030. Through an extensive review of archaeological literature, heritage management policies, tourism frameworks, and comparative case studies, the research identifies key opportunities and challenges associated with cave tourism development in Pakistan. The study proposes an integrated framework emphasizing digital documentation, conservation planning, community participation, infrastructure development, policy reform, and sustainable visitor management. The findings demonstrate that adopting international best practices while respecting local cultural and environmental contexts can transform Pakistan's cave heritage into a significant driver of cultural tourism, regional economic development, scientific research, and heritage preservation. The proposed framework provides practical guidance for policymakers, heritage professionals, tourism authorities, and researchers seeking to promote sustainable cave tourism while ensuring the long-term protection of Pakistan's invaluable underground cultural landscapes.

1. Introduction

Caves represent some of the oldest repositories of human history, preserving invaluable evidence of prehistoric occupation, cultural evolution, geological processes, and environmental change. Throughout the world, caves have served as shelters, ritual spaces, religious sanctuaries, habitation sites, and repositories of archaeological materials that provide unique insights into human adaptation over thousands of years. Beyond their archaeological importance, caves also constitute significant geological and ecological assets, attracting researchers, adventure tourists, and heritage enthusiasts alike (Gillieson, 2011; UNESCO, 2021).

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In recent decades, cave tourism has emerged as an important component of sustainable heritage tourism. Countries such as Slovenia, France, China, Australia, Spain, and more recently Saudi Arabia have successfully integrated cave heritage into national tourism strategies by balancing conservation, scientific research, digital documentation, and visitor management. These initiatives have demonstrated that well-managed cave tourism contributes not only to local economic development but also to heritage conservation, community participation, and public education.

Pakistan possesses exceptional cave heritage distributed across diverse geological and cultural landscapes. Archaeological caves such as Sanghao Cave in Khyber Pakhtunkhwa preserve evidence of Middle Palaeolithic occupation, while Shah Allah Ditta Caves represent important Buddhist monastic heritage along the ancient Silk Routes. Likewise, the Gondrani Caves of Balochistan, Kach Gharra, Khanpur Cave, and numerous limestone cave systems collectively reflect Pakistan's rich prehistoric, historical, geological, and religious heritage. Despite their outstanding significance, these sites remain poorly documented, inadequately protected, and largely absent from national tourism planning.

Several challenges continue to hinder the development of cave tourism in Pakistan. These include inadequate infrastructure, limited digital documentation, weak conservation policies, insufficient visitor management, lack of community engagement, and minimal integration between archaeological research and tourism planning. Climate change, uncontrolled urban expansion, vandalism, and natural weathering further threaten the long-term preservation of these fragile heritage landscapes.

Saudi Arabia provides an excellent regional example of successful heritage transformation. Under Vision 2030, the Kingdom has invested heavily in heritage conservation, geotourism, archaeological research, digital documentation, and visitor infrastructure, particularly at sites such as AlUla and other geoheritage destinations. These initiatives demonstrate how archaeological and geological heritage can be transformed into sustainable tourism resources while maintaining international conservation standards.

The present study therefore explores how Pakistan can adapt these successful approaches to establish a sustainable framework for cave tourism development. By comparing Pakistan's cave heritage with Saudi Arabia's recent achievements, the study proposes an integrated model combining heritage conservation, digital archaeology, community participation, policy development, and sustainable tourism planning.

Unlike previous studies that primarily describe individual caves or focus solely on archaeological significance, this research develops a comprehensive framework linking cave heritage, digital documentation, conservation, tourism development, and sustainable management. The proposed framework aims to support policymakers, heritage managers, tourism authorities, and researchers in promoting responsible cave tourism while ensuring the long-term protection of Pakistan's underground cultural heritage.

Although several studies have documented individual cave sites in Pakistan, there remains no comprehensive framework integrating archaeological documentation, conservation planning, digital heritage technologies, sustainable tourism, and community participation. Furthermore, comparative analyses between Pakistan and successful regional models, particularly Saudi Arabia, remain limited. This study addresses this gap by proposing an integrated sustainable cave tourism framework that combines international best practices with Pakistan's unique archaeological and environmental contexts.

2. Literature Review

2.1 Global Development of Cave Tourism

Cave tourism has evolved into one of the fastest-growing branches of geotourism and heritage tourism worldwide. Initially centred on recreational visits to spectacular cave systems, it has gradually expanded to include archaeological research, geological conservation, environmental education, cultural heritage interpretation, and sustainable regional development. International organizations, including UNESCO and ICOMOS, recognize caves as valuable cultural and natural heritage resources that require integrated conservation and tourism management strategies (Gillieson, 2011; UNESCO, 2024).

Countries such as Slovenia, France, Spain, Australia, China, and the United States have successfully integrated cave heritage into national tourism policies through scientific documentation, visitor

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management, conservation planning, digital interpretation, and community participation. More recently, Saudi Arabia has significantly expanded its geoheritage and cave tourism initiatives under Vision 2030, demonstrating how geological and archaeological resources can contribute to economic diversification while maintaining conservation standards (Forti et al., 2010; Sen et al., 2024).

2.2 Cave Heritage and Sustainable Tourism

Sustainable cave tourism extends beyond visitor attraction by integrating archaeological preservation, environmental conservation, local economic development, education, and community participation. UNESCO's Sustainable Tourism Programme emphasizes that heritage conservation and tourism development should operate together through participatory management, stakeholder engagement, and long-term protection of cultural and natural values (UNESCO, 2024).

Previous studies demonstrate that successful cave tourism depends upon balancing tourism infrastructure with heritage protection while minimizing ecological disturbance. Effective visitor management, carrying-capacity assessment, interpretation facilities, conservation monitoring, and community involvement are considered essential components of sustainable cave tourism management (Gillieson, 2011; Sen et al., 2024). Recent literature identifies five interconnected pillars supporting sustainable cave tourism:

i. Heritage conservation
ii. Scientific documentation
iii. Community participation
iv. Sustainable visitor management
v. Digital interpretation

Collectively, these components contribute to achieving several Sustainable Development Goals, particularly SDGs 8 (Decent Work and Economic Growth), 11 (Sustainable Cities and Communities), 13 (Climate Action), and 15 (Life on Land) (UNESCO, 2024).

2.3 Digital Archaeology in Cave Documentation

Rapid advances in digital archaeology have transformed the documentation, monitoring, and management of cave heritage. Technologies including UAV photogrammetry, terrestrial laser scanning (TLS), Structure-from-Motion (SfM), Geographic Information Systems (GIS), LiDAR, and three-dimensional modelling enable highly accurate recording of archaeological contexts while minimizing physical disturbance to fragile cave environments (UNESCO, 2024).

Digital documentation supports virtual preservation, condition monitoring, heritage inventories, archaeological recording, conservation planning, public interpretation, and digital museums. Consequently, digital archaeology has become an indispensable component of sustainable heritage management and provides new opportunities for research, education, and public engagement (UNESCO, 2024; Kononova et al., 2021).

2.4 Lessons from Saudi Arabia

Saudi Arabia has emerged as a leading regional example of integrating archaeology, geology, tourism, and digital heritage under Vision 2030. Large-scale investments in AlUla and other geoheritage destinations illustrate how archaeological landscapes can be managed through conservation planning, digital documentation, infrastructure development, visitor management, and international collaboration (Sen et al., 2024).

Saudi Arabia's experience demonstrates that sustainable cave tourism requires strong governmental commitment, modern conservation policies, scientific documentation, international partnerships, digital technologies, and active community participation. These initiatives provide an important model for Pakistan as it seeks to develop its own cave heritage resources through sustainable tourism and heritage conservation (Forti et al., 2010; Saudi Gazette, 2021).

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Table 1- Comparative Review of Previous Studies

Author	Country	Main Focus	Digital Methods	Tourism	Conservation	Research Gap
Gillieson (2011)	Australia	Cave Ecology	No	Partial	Yes	Limited tourism integration
UNESCO (2021)	Global	Heritage Management	Partial	Yes	Yes	Limited digital workflow
Abdul Aziz et al.	Saudi Arabia	Geotourism	Yes	Yes	Yes	Focus on Saudi Arabia
Zhou et al.	China	Cave Tourism	Yes	Yes	Partial	Limited archaeology
Pérez et al.	Spain	Speleotourism	Partial	Yes	Yes	No digital archaeology
Present Study	Pakistan	Integrated Cave Heritage	Yes	Yes	Yes	Comprehensive framework

3. Research Gap, Problem Statement, and Contribution

The existing body of literature has made significant contributions to archaeological research, cave conservation, geoheritage management, and digital documentation. Numerous studies have explored the archaeological significance of individual cave sites, geological characteristics, heritage conservation, and tourism potential in different regions of the world. However, these studies generally examine these themes independently, with limited integration of archaeological documentation, digital heritage technologies, climate resilience, governance mechanisms, community participation, and sustainable tourism within a comprehensive management framework specifically applicable to Pakistan (Gillieson, 2011; UNESCO, 2024).

Pakistan possesses a remarkable diversity of cave heritage, including the Shah Allah Ditta Caves near Islamabad, the Gondrani Caves in Balochistan, the Kai Caves in Sindh, Sanghao Cave in Khyber Pakhtunkhwa, and Khanpur Cave in Haripur. These caves collectively represent an exceptional record of geological evolution, prehistoric occupation, religious traditions, and cultural interactions spanning from the Stone Age to the medieval period. Archaeological investigations have revealed evidence of Buddhist meditation chambers, Shaivite shrines, prehistoric occupations, petroglyphs, inscriptions, and anthropomorphic motifs, highlighting Pakistan's strategic role in regional cultural exchange and trade networks, particularly along the ancient Silk Road (Dani, 1983; Arif, 2002; Khan et al., 2017).

Despite their outstanding archaeological, historical, ecological, and tourism significance, Pakistan's cave heritage remains substantially underexplored, inadequately documented, poorly conserved, and largely excluded from organized tourism planning and national heritage development policies. Many cave sites suffer from insufficient legal protection, limited scientific documentation, inadequate visitor infrastructure, weak conservation management, and a lack of public awareness. Furthermore, climate change, natural weathering, vandalism, urban expansion, and uncontrolled tourism continue to accelerate the deterioration of these fragile cultural landscapes. Sites such as Kach Gharra Cave, Lahoot Lamakan, Pir Ghaib, Shah Allah Ditta, Sanghao, and Khanpur Cave increasingly face conservation challenges due to inadequate management and unsustainable visitation practices (Kakar, 2003; Kalhoro, 2010; UNESCO, 2024).

At the same time, the application of advanced digital heritage technologies including Geographic Information Systems (GIS), unmanned aerial vehicle (UAV) photogrammetry, terrestrial laser scanning (TLS), Structure-from-Motion (SfM), three-dimensional (3D) modelling, and digital archiving remains limited within Pakistan's cave heritage management. Consequently, comprehensive digital inventories,

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condition monitoring systems, and long-term conservation databases for cave heritage are largely absent. This technological gap restricts effective documentation, heritage monitoring, disaster preparedness, virtual accessibility, and evidence-based conservation planning.

Conversely, Saudi Arabia has demonstrated how archaeological and geological heritage can be successfully integrated into sustainable tourism through the implementation of Vision 2030. Large-scale investments in archaeological research, digital documentation, geoheritage conservation, visitor infrastructure, community engagement, and international collaboration have transformed heritage landscapes into globally recognized cultural tourism destinations while maintaining high conservation standards. These experiences provide valuable lessons that can be adapted to Pakistan's archaeological and cultural contexts to support sustainable cave tourism development (Olivieri et al., 2014; Tribulato & Olivieri, 2017; Sen et al., 2024).

Against this background, a significant research gap remains regarding the development of an integrated framework that combines archaeological documentation, digital heritage technologies, conservation planning, climate resilience, governance mechanisms, stakeholder participation, and sustainable tourism specifically for Pakistan's cave heritage. Existing studies rarely adopt an interdisciplinary perspective that simultaneously addresses heritage preservation, digital archaeology, tourism development, environmental sustainability, and policy implementation.

Therefore, this study seeks to bridge this gap by proposing a comprehensive framework for the sustainable development of cave tourism in Pakistan, drawing upon successful heritage management practices implemented in Saudi Arabia. The framework integrates archaeological research, digital documentation, conservation strategies, stakeholder engagement, community participation, and sustainable tourism planning to support evidence-based decision-making. The findings are expected to provide practical guidance for policymakers, heritage managers, tourism authorities, researchers, and local communities while contributing to the achievement of the United Nations Sustainable Development Goals (SDGs), particularly SDG 8 (Decent Work and Economic Growth), SDG 11 (Sustainable Cities and Communities), SDG 13 (Climate Action), and SDG 15 (Life on Land). Ultimately, the proposed framework aims to transform Pakistan's rich cave heritage into a sustainable cultural tourism resource while ensuring its long-term conservation for future generations.

4. Heritage Caves of Pakistan: Archaeological Significance and Tourism Potential

Pakistan possesses one of South Asia's most diverse cave landscapes, encompassing prehistoric habitation caves, Buddhist monastic caves, Hindu sacred caves, geological cave systems, and natural karst formations distributed across all major provinces. These caves collectively preserve evidence of human occupation spanning from the Lower and Middle Palaeolithic periods to the medieval era. Besides their archaeological importance, they represent valuable geological, ecological, religious, and tourism resources capable of contributing significantly to sustainable cultural tourism and regional socio-economic development (Dani, 1983; Khan et al., 2017; UNESCO, 2024).

Despite this remarkable diversity, Pakistan's cave heritage remains among the least documented archaeological resources in South Asia. Many cave sites lack comprehensive archaeological surveys, digital documentation, visitor interpretation facilities, conservation plans, and sustainable tourism management. Consequently, numerous sites face increasing threats from natural weathering, climate change, vandalism, uncontrolled visitation, and urban expansion (Gillieson, 2011; UNESCO, 2024).

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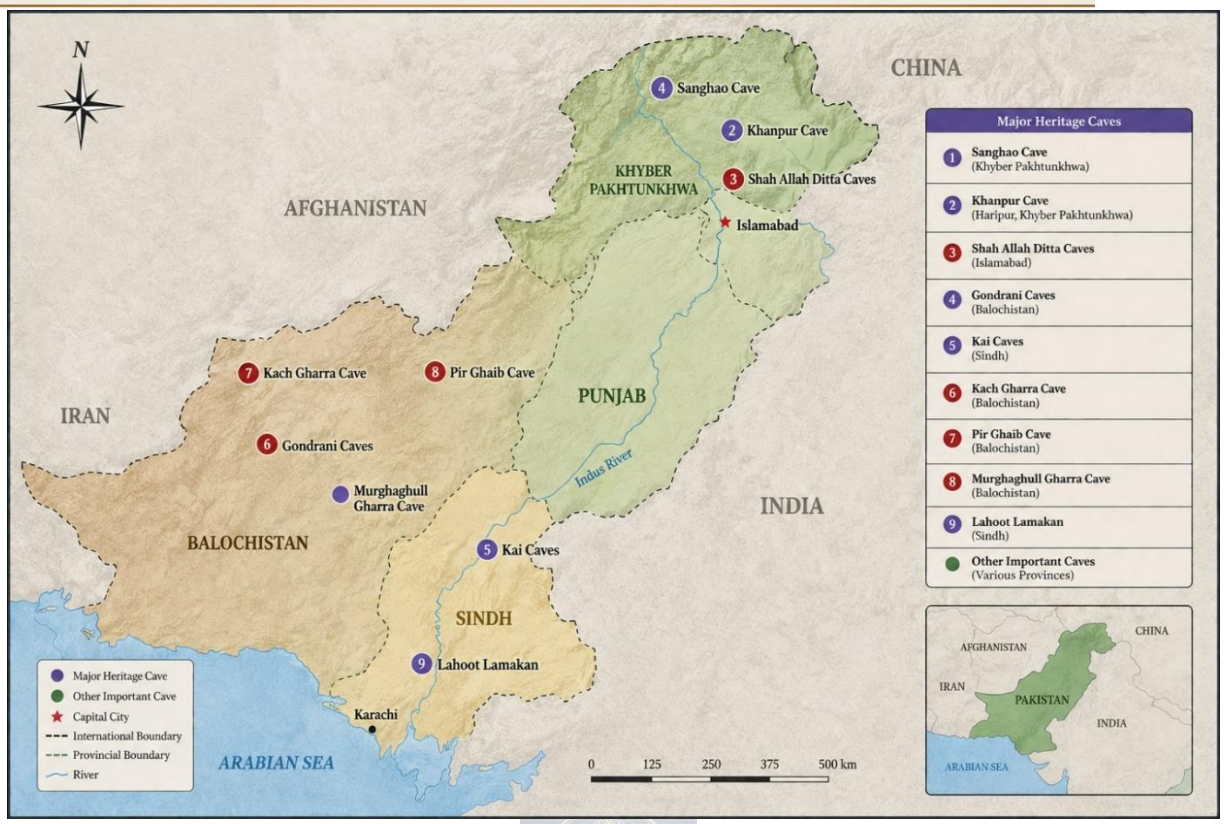


Figure 1. Geographic distribution of major archaeological, religious, and geological cave heritage sites in Pakistan discussed in this study.

4.1 Classification of Heritage Caves

Pakistan's caves can be classified into five principal categories according to their origin, archaeological significance, and tourism value.

Table 2. Classification of Heritage Caves in Pakistan

Category	Examples	Significance	Tourism Type
Prehistoric Caves	Sanghao	Human evolution, Stone Age	Archaeological Tourism
Buddhist Caves	Shah Allah Ditta	Monastic heritage	Religious Tourism
Hindu Sacred Caves	Katas, Lahoot Lamakan	Pilgrimage	Spiritual Tourism
Geological Caves	Khewra, Khanpur	Karst geology	Geotourism
Natural Adventure Caves	Gondrani, Kach Gharra	Adventure, landscape	Adventure Tourism

4.2 Major Heritage Caves

- **Bazar Caves**

The Bazar Caves, also known as the Bāzār Caves, are a notable geological feature located in the Khyber District of Pakistan, within the mountainous region of the Federally Administered Tribal Areas (FATA). This area is characterized by its rugged terrain and significant historical importance, serving as a critical passageway between Afghanistan and Pakistan. The Bazar Caves are situated in close proximity to the Khyber Pass, a historically significant mountain pass that connects Peshawar in Pakistan to Kabul in Afghanistan. The Khyber Pass has been a vital trade route for centuries, facilitating the movement of

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goods and armies across this strategic landscape. The caves themselves are part of a broader network of natural formations that have been shaped by geological processes over millennia.

Today, the Bazar Caves serve as a tourist attraction, drawing visitors interested in exploring their natural beauty and historical context. The Khyber District is accessible from major cities like Peshawar, making it a feasible destination for adventure seekers and history enthusiasts alike. However, travelers are advised to be aware of local conditions and security situations before visiting.

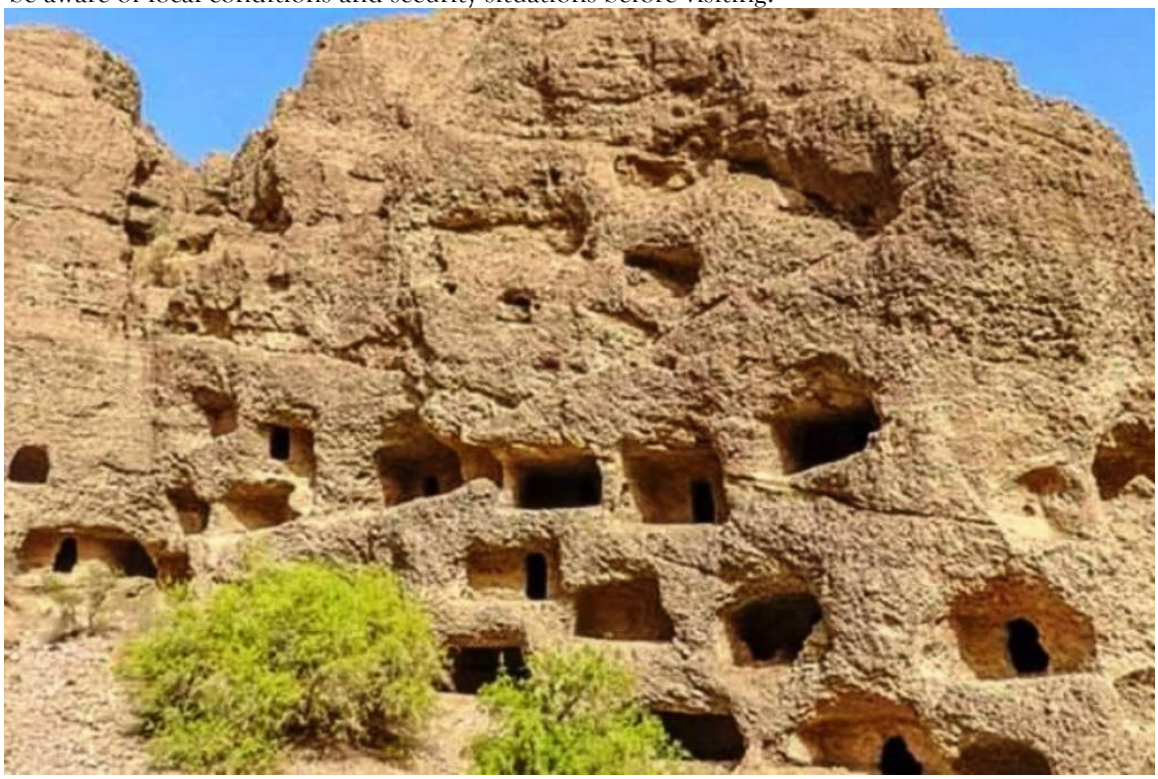


Figure 2. Overview of the Bazar caves Khyber District, Khyber Pakhtunkhwa

Gondrani, also known as Shehr-e-Roghan or the "City of Caves," is an archaeological site located in the Lasbela district of Balochistan, Pakistan. Situated approximately 20 kilometers north of Bela and about 175 kilometers from Karachi, it is renowned for its ancient man-made caves that were primarily created by a Buddhist community for meditation and religious practices.

The Gondrani caves are believed to date back to the 8th century, although some accounts suggest they may have origins as far back as the 7th century. Originally, there were around 1,500 caves, but only about 500 remain today due to erosion and harsh climatic conditions. These caves are carved into solid conglomerate rock and feature interconnected pathways, small chambers with hearths, and niches for lamps, reflecting the architectural skills of their creators.

Gondrani can be accessed via the Karachi-Quetta Highway (N-25) or through a bumpy track leading from Bela. The journey typically takes about two to three hours by road from Karachi. Despite its remote location, Gondrani has become an intriguing destination for tourists interested in archaeology and history, offering a glimpse into an ancient civilization that thrived in this rugged landscape. The site is not only significant for its historical and cultural aspects but also for its natural beauty. The Kurd River flows through the valley, adding to the scenic landscape surrounding the caves, making it a captivating spot for visitors.

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- **Kai Caves**

Kai Caves are located in the historic Kai Valley of Sindh, Pakistan, positioned to the south of Sehwan Sharif in the Jamshoro District, within the Kirthar Mountain Range. This site features two distinct cave groups: the upper caves, situated on a high hill to the east, and the lower caves, known as "Satt Ghariyoon" or "Seven Caves," located on a lower hill to the west.

The upper caves are notable for their proximity to an ancient compound wall constructed from stone, which encircles the hilltop. Archaeological explorations in this area have uncovered remnants of a long-lost settlement, including ancient potsherds. These artifacts are indicative of the early Indus Valley civilization, while the caves themselves are believed to date back to the Stone Age. Alongside the Kai Caves, additional sites such as Bulo-Ji-Buthi, Nuko-Buthi, Kai-Buthi, and Naig have been identified nearby, all of which belong to prehistoric and Chalcolithic periods. Despite its rich history and archaeological importance, the Kai Caves have faced neglect over the years. Once regarded as a significant archaeological site, they have deteriorated into little more than shelters for animals and dumping grounds for waste. The surrounding landscape still offers a glimpse into its ancient past, with swaying date palms and hills that evoke a sense of timelessness. Experts continue to debate the exact historical context of these caves.



Figure 3. Overview of the Kai Caves Sindh

- **Kach Gharra**

Kach Gharra cave, located in Balochistan, Pakistan, is recognized as the country's deepest explored cave, featuring a remarkable depth of 127 meters and a passage length of 350 meters. This cave is situated near Ziarat, at a significant altitude, making it an important site for both geological and speleological studies. Positioned in the Zarghoon Mountain Range, approximately 65 km from Quetta.

Kach Gharra is notable not only for its depth but also for its geological formations and potential for further exploration. The cave is part of the rich geological heritage of Balochistan and offers insights into the region's natural history. Its exploration has been conducted by various caving organizations, contributing to the understanding of cave systems in Pakistan. The cave has been subject to exploration efforts by local caving enthusiasts and researchers, highlighting its importance in the field of speleology. The ongoing research and exploration may uncover more about its geological formations and ecological significance.

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- **Kashmir Smast Cave**

Kashmir Smast, located in the Babozai mountains of Mardan District, Khyber Pakhtunkhwa, Pakistan, is a significant archaeological site consisting of a series of natural limestone caves. These caves are believed to have been expanded during the Kushan Empire and continued to be used through the Shahi periods, making them a vital link to early Hinduism and Buddhist practices in the region. Kashmir Smast is recognized as one of the oldest Shaivite sites in the Indian subcontinent, serving as an important center for Hinduism from the 2nd to the 10th centuries CE. This period saw a flourishing of religious and cultural activities, supported by trade routes connecting the Indian subcontinent to Central Asia. The site provides crucial insights into early Hindu practices and beliefs, significantly altering our understanding of the historical timeline of Hinduism in Northwestern India. The caves are characterized by their lofty and spacious interiors, with a long corridor illuminated by natural light from the entrance. This corridor is flanked by ruins that likely belonged to monastic dwellings. The main cave, known as Maha Guha or Great Cave, consists of three chambers used for meditation and prayer by ascetics. The architecture reflects influences from Greco-Buddhist styles, similar to those found at other sites like Takht-i-Bahi. Despite its historical significance, Kashmir Smast has faced challenges due to illegal excavations and neglect. Systematic archaeological efforts began in 2001 under Dr. Nasim Khan's direction, aiming to study and preserve this important cultural site. These efforts have revealed extensive information about its historical context and architectural features.



Figure 4. Overview of the Kashmir Smast Cave **of Mardan District, Khyber Pakhtunkhwa**

- **Katas Raj Caves**

Katas Raj Caves, located near Chakwal in Punjab, Pakistan, are a significant archaeological and religious site associated with Hindu mythology and history. The complex is primarily known for its Katas Raj Temples, which date back to the era of the Hindu Shahis, around 615-950 CE, and are dedicated to Lord Shiva. This site is recognized as one of the most important Hindu pilgrimage destinations in Pakistan, still frequented by devotees today.

The Katas Raj Temples are steeped in legend, particularly connected to the Mahabharata. It is believed that the site was visited by the Pandava brothers during their exile, and it is referred to as Dvaitavana in the epic. The temples commemorate their stay and interactions with mystical beings. Additionally, a local legend states that the sacred pond at Katas Raj was formed from the tears of Lord Shiva, mourning his wife Sati. The temple complex features a series of seven temples (Satghara), built on elevated platforms with architectural styles reminiscent of Kashmiri temples from the Karkota and Varma dynasties. The

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structures are characterized by fluted pillars, pointed roofs, and intricate carvings, primarily constructed from soft sandstone. Adjacent to the temple complex are several caves known as Sadhu's Houses, which were likely used by ascetics for meditation and refuge. These human-made caves maintain a constant temperature and have historically accommodated pilgrims seeking spiritual solace. The caves are part of a larger geological formation that has been shaped over millennia, with some suggesting they were inhabited by early humans before becoming places of worship. Katas Raj remains a vital cultural and religious symbol for Hindus in Pakistan and abroad. Despite the migration of many Hindus post-1947 partition, the site continues to attract visitors who seek to connect with their heritage and partake in religious rituals at this sacred location.



Figure 4. Overview of the Katas Raj Caves Chakwal Punjab

- **Khanpur Cave**

Khanpur Cave is an archaeological site located in Haripur near Taxila in Pakistan, recognized for its significant contributions to our understanding of prehistoric human habitation in the region.

The cave has yielded stratified microlithic tools dating back to the Mesolithic period, approximately 7000-10000 BC, indicating that it was inhabited during the Ice Age. These findings suggest that early humans utilized the cave for various activities, including tool-making and possibly shelter. The site is part of the larger Taxila archaeological complex, which includes remnants of ancient Buddhist monasteries and other historical structures that reflect the area's rich cultural heritage. Taxila itself was a crucial center for education and culture from the 5th century BC to the 2nd century AD, influenced by various civilizations including Persian, Greek, and Central Asian cultures. The presence of Khanpur Cave within this context highlights its importance as a location where early human activity intersected with later historical developments in the region. Archaeologists have discovered numerous stone tools and artifacts within Khanpur Cave, which provide insights into the daily lives of its prehistoric inhabitants. These tools are significant not only for their age but also for their craftsmanship, showcasing the technological advancements of early humans in this part of the world. Khanpur Cave measures approximately 2.60 by 1.80 meters and is characterized by thick vegetation surrounding its entrance. Its geographical coordinates place it strategically within the rich archaeological landscape of Taxila, making it accessible for both research and tourism.

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Figure 5. Overview of the Khanpur Cave Haripur Khyber Pakhtunkhwa

- **Lahoot Lamakan Caves**

Lahoot Lamakan, located in the Khuzdar District of Balochistan, Pakistan, is a sacred cave that attracts numerous pilgrims, particularly from the Shia Muslim community. The name "Lahoot Lamakan" translates to "the place beyond the world" or "where there's no place," signifying its spiritual significance and mystical aura. It is situated approximately 110 kilometers northwest of Karachi, making it accessible yet remote, often requiring a 4×4 vehicle or local guides to navigate the rugged terrain. The cave is closely associated with Shah Bilawal Noorani, a revered Sufi saint believed to have lived in the 15th century. According to local legends, he used the cave for prayer and spiritual healing. The site is also linked to Ali, the first Shia Imam and cousin of Prophet Muhammad, who is said to have visited the area during his life. Myths surrounding Ali include tales of him defeating a giant named Gokul Deo and leaving behind footprints that are still venerated today. The pilgrimage to Lahoot Lamakan typically occurs during the Islamic month of Muharram, where devotees undertake a journey from Sehwan Sharif, stopping at various shrines along the way. This trek can span around 200 kilometers and takes about two weeks to complete, with pilgrims resting at designated stations. The cave itself features unique geological formations, including limestone stalactites that are said to ooze water, which locals historically believed was milk. This transformation into water is attributed to the commercialization of the "milk" by pilgrims. The area is rich in natural beauty, with fresh springs flowing from nearby mountains and various rituals performed by visitors seeking blessings and purification.

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Figure 6. Overview of the Lahoot Lamakan Caves Khuzdar District Balochistan

- **Pir Ghaib Caves**

Pir Ghaib is a notable site located approximately 70 kilometers from Quetta in the Bolan Valley of Balochistan, Pakistan. It features a stunning waterfall and is surrounded by limestone caves, making it a significant natural and cultural landmark. The name "Pir Ghaib" translates to "The Invisible Saint," referring to a legendary figure associated with the site. The legend surrounding Pir Ghaib tells of a Muslim saint, known as Pir Ghaib, who, along with his sister Bibi Nani, sought to guide a cruel king towards Islam. When their mission was thwarted by the king's army, they fled. In a moment of desperation, Pir Ghaib prayed for divine intervention, which led to a miraculous opening in the mountain that allowed him to escape. This event is commemorated by the waterfall that cascades from the mountain. The area not only includes the waterfall but also limestone caves that add to its mystical allure. These caves are part of local folklore and are believed to have been inhabited by supernatural beings in ancient times. The caves serve as a reminder of the rich history and cultural narratives that permeate the region. Pir Ghaib has become a pilgrimage site for many, particularly among local Hindus who revere Pir Ghaib as Mahadev. The site is also significant for its historical connections to early travelers from the Indus Valley who would stop at this sacred spring during their journeys.In summary, Pir Ghaib is not only a natural wonder with its waterfall and caves but also a site steeped in legend and cultural significance, attracting visitors and pilgrims alike.

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Figure 7. Overview of the Pir Ghaib Caves Quetta Baluchistan

- **Shah Allah Ditta Caves**

Shah Allah Ditta Caves, located in the Margalla Hills near Islamabad, Pakistan, are an ancient archaeological site with a rich historical background. Believed to be around 2,400 years old, these caves were initially used by Buddhist monks for meditation and later by Hindu sadhus and Muslim ascetics during the Mughal period. The village of Shah Allah Ditta, where the caves are situated, is named after a Mughal-era dervish and has been a significant stopover for travelers since ancient times, including notable figures such as Alexander the Great and Sher Shah Suri on their way to the Gandharan city of Taxila. The caves hold immense historical value as they were part of a route that facilitated trade and travel between Kabul and India. This area has witnessed various civilizations over centuries, with archaeological findings indicating human activity dating back to the 8th century. The caves feature numerous Buddha carvings and murals that attract both tourists and historians alike. Archaeological excavations have revealed remnants from different periods, including burnt diyas and other artifacts that provide insights into the lives of the inhabitants. The caves consist of two natural rock shelters flanking a spring, with evidence of past fires visible on the walls due to soot accumulation. In recognition of their cultural importance, efforts have been made to preserve the Shah Allah Ditta Caves. In 2010, a conservation plan was approved by the Capital Development Authority (CDA) to protect this heritage site. The plan includes restoring the caves and enhancing the surrounding area, including the adjacent garden known as Sadhu ka Bagh. International support has also been sought, with the Embassy of Japan offering funding for preservation initiatives.

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Figure 8. Overview of the Shah Allah Ditta Caves Islamabad

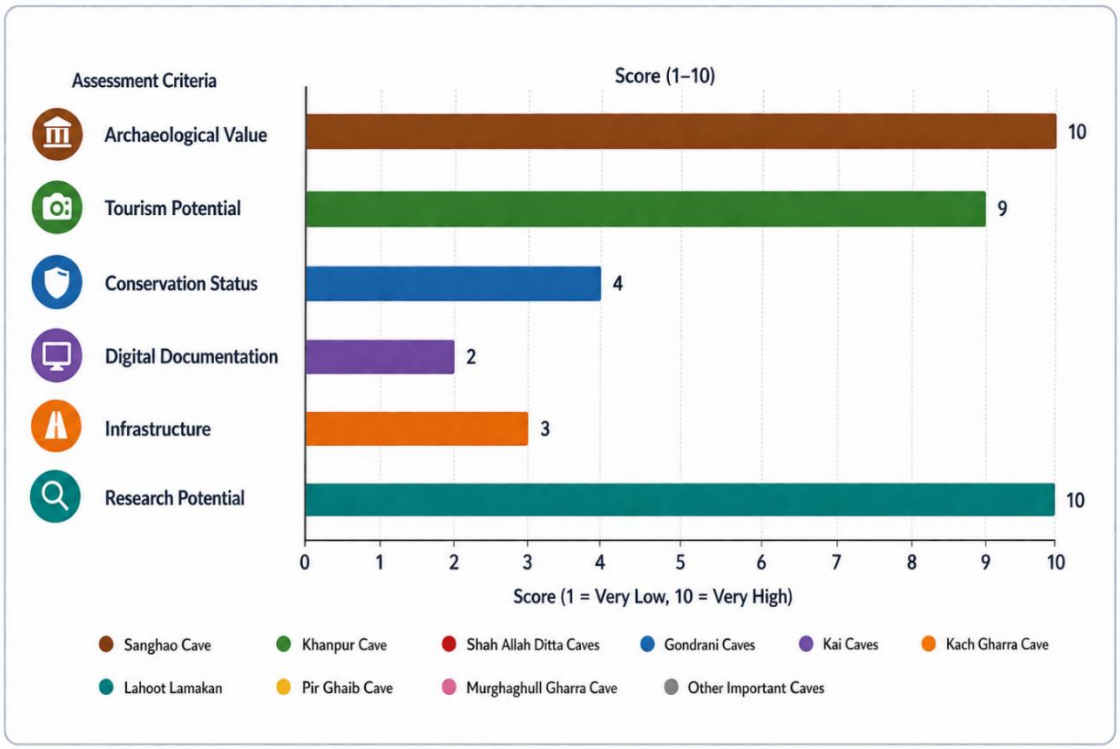


Figure 9. Heritage Value Assessment Archaeological Value

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Table 3. Threat Assessment Framework

S. No.	Principal Threat	Description	Impact on Cave Heritage
1	Climate Change	Rising temperatures and changing precipitation patterns accelerate deterioration.	Structural instability, environmental degradation, and long-term damage to cave environments.
2	Weathering	Rainwater, humidity, and temperature fluctuations cause physical and chemical erosion.	Surface erosion, mineral dissolution, and deterioration of natural and cultural features.
3	Vandalism	Graffiti, scratching, and deliberate visitor damage affect cave surfaces.	Damage to rock art, inscriptions, and other cultural features, resulting in loss of historical information.
4	Urban Expansion	Infrastructure and settlement development encroach upon heritage sites and surrounding areas.	Site destruction or fragmentation, landscape alteration, and increased pollution.
5	Illegal Excavation	Unregulated digging and treasure hunting disturb archaeological deposits.	Loss of archaeological layers, artifacts, contextual information, and scientific value.
6	Tourism Pressure	High visitor numbers, inadequate management, and insufficient facilities increase site pressure.	Physical wear, littering, disturbance, overcrowding, and degradation of sensitive features.
7	Loss of Heritage	The cumulative effect of multiple threats produces irreversible deterioration.	Permanent loss of cultural identity, historical knowledge, archaeological evidence, and natural heritage.

Table 3 illustrates the major threats affecting the long-term conservation of Pakistan's cave heritage and demonstrates that these threats are interconnected rather than isolated. Climate change and weathering represent major environmental pressures that can gradually weaken cave surfaces, rock formations, inscriptions, and other sensitive features. Changes in temperature, precipitation, humidity, and water movement may accelerate physical and chemical deterioration over time.

The figure also highlights human-induced threats, particularly vandalism, urban expansion, illegal excavation, and tourism pressure. Vandalism can directly damage rock art, inscriptions, and cave surfaces, while uncontrolled urban development may encroach upon archaeological sites and their surrounding landscapes. Illegal excavation is especially damaging because it not only removes archaeological materials but also destroys the stratigraphic and contextual information necessary for scientific interpretation. Similarly, unmanaged tourism can contribute to physical deterioration, littering, overcrowding, and disturbance of fragile cave environments.

The final category, loss of heritage, represents the cumulative consequence of these environmental and human pressures. The figure therefore suggests a progression in which individual threats can interact and collectively contribute to irreversible damage and the loss of archaeological, cultural, historical, and natural values. Importantly, the table indicates that conservation challenges cannot be addressed through

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a single intervention. Effective protection of Pakistan's cave heritage requires scientific documentation, regular monitoring, conservation measures, controlled tourism, protection from illegal excavation and vandalism, appropriate site management, and stronger institutional and community involvement.

5. Cave Tourism in the Kingdom of Saudi Arabia

Caves and caverns are distributed across several regions of the Kingdom of Saudi Arabia and represent an important component of its geological, environmental, religious, and cultural heritage. In addition to caves primarily associated with geological and adventure tourism, the Kingdom contains caves of exceptional religious and historical significance, particularly in the Makkah region. Among the most prominent is Ghar Hira (Cave of Hira), located at the summit of Jabal al-Nour in Makkah. The cave is one of the most significant Islamic historical sites in Saudi Arabia and is associated with the first revelation received by Prophet Muhammad (PBUH). The cave is a small cavity within the mountain, with an entrance approximately four metres long and one metre wide, accommodating only a few visitors at a time. Jabal al-Nour and Ghar Hira have increasingly become part of organized cultural and historical visitor experiences, supported by the development of the Hira Cultural District and related visitor facilities. Another important site is Ghar Thawr (Cave of Thawr), located on Jabal Thawr, south of Makkah. The cave is historically associated with the Hijrah (migration) of Prophet Muhammad (PBUH) and his companion Abu Bakr al-Siddiq (RA), who sought refuge there during their migration to Madinah. The cave therefore represents an important intersection of natural landscape, religious history, and cultural tourism. The development of the Jabal Thawr Cultural District, including visitor and interpretive facilities, demonstrates the potential for integrating religious heritage with sustainable cultural tourism.

The wider Makkah landscape also includes historically significant mountains such as Jabal al-Rahmah (Mount of Mercy) in Arafat. Although Jabal al-Rahmah is not a cave site, it is highly relevant to religious and heritage tourism because of its association with the Hajj landscape and the Farewell Sermon of Prophet Muhammad (PBUH). It can therefore be discussed as part of a broader category of religious landscape tourism, alongside Jabal al-Nour and Jabal Thawr.

From the perspective of geological and adventure tourism, several caves are particularly noteworthy. Shu'fan Cave, located in Harrat an-Nar south of Hail Province, is among the large recently documented cave systems and is characterized by distinctive geological formations. Darb al-Najm Cave, located in the eastern desert of Al-Majma'ah, has a deep cavity accessible by rope and therefore has potential for adventure and climbing tourism. Umm Jirsan Cave, in Harrat Khaybar north of Madinah, is another major cave system and is notable for its considerable length and geological characteristics. Other examples include Dahal al-Tahalib, Al-Fondok, and Al-Murabba caves in the As-Samman area northeast of Riyadh, as well as Black Scorpion Cave in the Northern Borders Province. The volcanic landscapes of Harrat Khaybar also contain lava tubes and volcanic caves, including Umm Ghraimil, which contains animal-bone remains and bird nests, demonstrating the potential significance of such caves for both geological and environmental research. Thus, Saudi Arabia's cave tourism resources can broadly be divided into three interconnected categories: geological and adventure caves, archaeological and palaeoenvironmental caves, and religious-historical caves. This diversity gives the Kingdom considerable potential to develop cave tourism beyond recreational visitation and toward a more comprehensive model incorporating geotourism, cultural heritage, archaeological research, environmental education, religious history, and community-based tourism. The development of Ghar Hira and Jabal Thawr in particular demonstrates how natural caves can be interpreted within wider historical and cultural landscapes rather than being treated merely as isolated geological attractions.

Model for Cave Tourism in Pakistan: Drawing Inspiration from Saudi Arabia

1. Site Selection and Protection

The first step is to select caves that are both geologically significant and culturally important. Pakistan has numerous heritage caves such as the Shah Allah Ditta, Gondrani, and Kach Gharra caves, which have historical and ecological value. These caves should be protected to prevent damage from unregulated

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tourism. Installing gates at cave entrances, especially for the most significant sites, will help regulate access and prevent vandalism.

2. Detailed Study of Caves

Each cave should undergo a thorough geological and structural assessment. This includes determining the "static stability" of areas to be accessed by tourists to ensure safety. Detailed mapping, surveying, and engineering evaluations of cave routes are essential. Lighting plans should also be developed to enhance visitor experience while preserving the natural beauty of the cave formations.

3. Environmental Monitoring

Just as in Saudi Arabia's As Sulb karst area, it's crucial to install environmental monitoring instruments to track temperature, humidity, and air flow inside the caves. These instruments will ensure the preservation of the caves by providing real-time data about the cave environment. Additionally, outdoor meteorological stations should be established to monitor weather conditions that could affect the caves, such as rainfall, wind speed, and humidity.

4. Surface Infrastructure and Facilities

Surface facilities such as parking areas, ticket booths, souvenir shops, and toilets must be planned in a way that does not negatively impact the surrounding environment. Sustainable waste disposal and water management systems must be implemented. The design of these facilities should blend with the natural environment to minimize visual disruption.

5. Development Stages

The development of cave tourism should be rolled out in stages, similar to the phased approach used in Saudi Arabia's Murubbeh Cave development:

- **Stage One (14 months)**: Development of basic infrastructure like lighting, paths, and interpretation centers (e.g., museum or information center).
- **Stage Two (28 months)**: Introduction of additional caves for tourism, such as Friendly Cave, with more adventurous elements like walking tours.
- **Stage Three (42 months)**: Expansion into caves like Surprise Cave, offering more adventure-based tours, including hiking and exploration, for tourists seeking thrill experiences.

6. Tourism Services and Staff

Training local guides and caretakers is essential. Guides should be knowledgeable about the cave's geology, history, and conservation efforts. Staff should also be trained in managing the environmental impact of tourism and providing a safe, educational experience for visitors. In addition to guides, security staff will be needed to ensure both cave preservation and tourist safety.

7. Promotion and Marketing

Effective marketing strategies will be crucial to attract both local and international tourists. The caves should be integrated into Pakistan's national tourism framework and marketed as part of the country's rich geological and cultural heritage. Social media campaigns, partnerships with tourism companies, and collaboration with international travel agencies will help raise awareness.

8. Pricing and Income Generation

Entrance fees should be determined based on the local economic context. A model similar to Saudi Arabia's, where tourists pay an average fee (around $10 or SR 37), can be adopted. The pricing strategy should also include group discounts, family packages, and off-season rates to attract a broad spectrum of visitors. Revenue from entrance fees can be reinvested in the conservation and maintenance of the caves and surrounding areas.

9. Cultural and Educational Integration

Educational and cultural programs can be developed to teach visitors about the historical and ecological importance of the caves. This can include interactive exhibits, video presentations, and guided educational tours that highlight the caves' unique geological formations, their role in the region's history, and their spiritual and cultural significance.

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10. Sustainable Tourism Practices

The overall development plan should prioritize sustainability. This involves minimizing the environmental footprint of tourism activities, such as using eco-friendly materials, conserving water, and promoting low-impact transportation options. Tourism must be balanced with the preservation of natural resources and local ecosystems.

Table 4 Three-Dimensional Economic Model for Pakistan Cave Heritage Tourism

Dimension	What it measures	Potential beneficiaries
Government Revenue	Entrance fees, permits, tourism licenses, concessions, heritage-site charges, and applicable taxes	Federal/provincial governments, tourism departments, archaeology & heritage authorities
Tourism Expenditure	Visitor spending on accommodation, transport, food, guides, entrance fees, adventure activities, shopping, and tour operators	Tourism businesses, guides, transporters, hotels, restaurants, local service providers
Local Economic Impact	Employment generation, growth of local businesses, community participation, handicrafts, infrastructure development, and circulation of tourism income	Local communities, entrepreneurs, workers, and destination economies

The economic potential of cave heritage tourism in Pakistan can be assessed through three interconnected dimensions: government revenue, tourism expenditure, and local economic impact. Government revenue represents the potential financial returns generated through entrance fees, permits, concessions, licenses, and related tourism charges. Tourism expenditure encompasses visitor spending on accommodation, transportation, food, guiding, entrance fees, recreational activities, and local products. The local economic impact extends beyond direct tourism expenditure and includes employment generation, growth of small businesses, community participation, infrastructure development, and the circulation of tourism income within local economies. Together, these three dimensions provide a comprehensive framework for evaluating the economic potential of Pakistan's cave heritage tourism while linking tourism development with conservation and community benefits.

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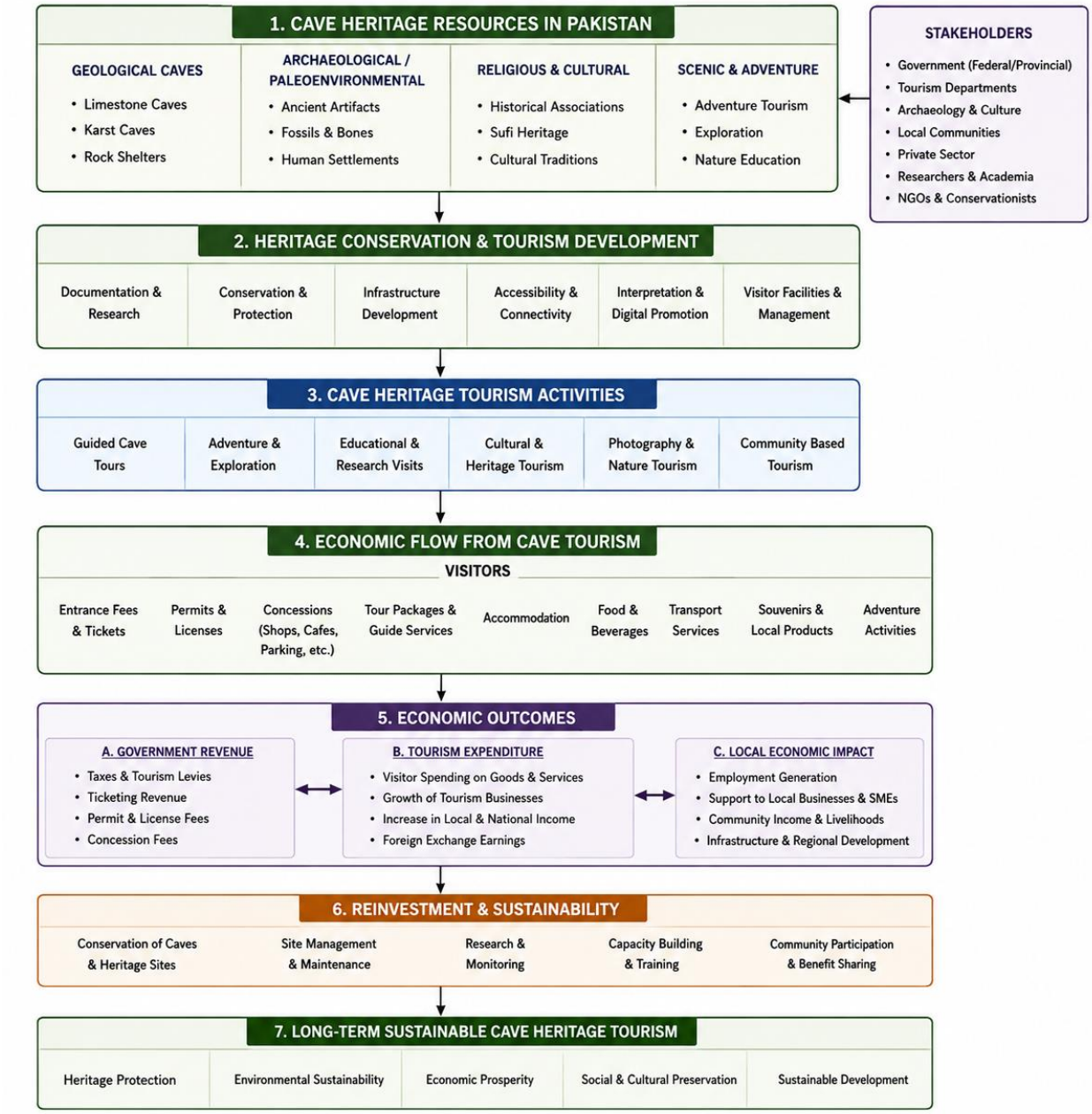


Figure 10. Sustainable Cave Heritage Tourism Model for Pakistan

The Sustainable Cave Heritage Tourism Model for Pakistan illustrates how the country's diverse cave heritage can be transformed into a sustainable tourism resource while ensuring long-term conservation and community benefits. The model follows a sequential but interconnected process, beginning with the identification of cave heritage resources and ending with sustainable heritage protection, economic prosperity, and social and cultural preservation. The first stage recognizes Pakistan's cave heritage as a multidimensional resource comprising geological, archaeological, palaeoenvironmental, religious, cultural, scenic, and adventure values. These resources provide the foundation for developing different forms of cave tourism. However, tourism development must be preceded by documentation, research, conservation, infrastructure development, accessibility, interpretation, digital promotion, and appropriate visitor management. This stage emphasizes that tourism should not be developed at the expense of the heritage resource.

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The third stage focuses on cave heritage tourism activities, including guided tours, adventure and exploration, educational and research visits, cultural and heritage tourism, photography and nature tourism, and community-based tourism. These activities create opportunities for visitors to engage with caves through different educational, recreational, scientific, and cultural experiences.

The fourth stage demonstrates the economic flow generated by visitors. Tourist expenditure may include entrance fees, permits, concessions, tour packages, accommodation, food, transportation, local products, and adventure activities. These expenditures subsequently generate three major economic outcomes: government revenue, tourism expenditure, and local economic impact. Government revenue can be generated through taxes, ticketing, permits, licenses, and concessions, while tourism expenditure supports tourism businesses and contributes to local and national income. At the community level, cave tourism can generate employment, strengthen small businesses and SMEs, increase household income and livelihoods, and contribute to regional infrastructure development. An important feature of the model is the reinvestment and sustainability stage. Economic benefits generated through tourism should contribute, directly or indirectly, to cave conservation, site management, research and monitoring, capacity building, and community participation. This creates a feedback mechanism in which tourism contributes to the protection of the very heritage resources upon which tourism depends.

6. Conclusion

Pakistan possesses a rich and diverse cave heritage that encompasses prehistoric habitation, Buddhist and religious traditions, archaeological deposits, geological formations, rock art, inscriptions, and culturally significant landscapes. Despite this exceptional heritage value, many cave sites remain underexplored, inadequately documented, poorly conserved, and largely absent from systematic tourism planning. The study demonstrates that climate change, natural weathering, vandalism, urban expansion, illegal excavation, and unmanaged tourism collectively pose serious risks to the long-term survival of these fragile heritage resources. The comparative examination of Saudi Arabia demonstrates that cave and geoheritage resources can be incorporated into broader national tourism strategies through appropriate infrastructure, scientific research, interpretation, trained personnel, environmental monitoring, and sustainable visitor management. The Saudi experience, however, should not be replicated mechanically; rather, its relevant principles should be adapted to Pakistan's archaeological, environmental, cultural, institutional, and socioeconomic contexts. The proposed Sustainable Cave Heritage Tourism Model for Pakistan provides a framework connecting heritage identification and protection with documentation, conservation, tourism development, visitor services, community participation, and economic benefits. The model recognizes three major economic dimensions government revenue, tourism expenditure, and local economic impact while emphasizing that tourism-generated benefits should contribute to conservation, research, site management, and local development.

The future of Pakistan's cave tourism depends on achieving a careful balance between access and protection, tourism and conservation, economic development and community interests. Cave tourism should therefore be developed as a conservation-led form of cultural and geotourism rather than as uncontrolled commercial exploitation. Establishing a national inventory of cave heritage, undertaking systematic archaeological and scientific documentation, developing site-specific conservation and carrying-capacity plans, strengthening institutional coordination, training local communities and guides, and introducing digital monitoring systems should be considered priorities. If implemented effectively, Pakistan's cave heritage can become more than an underutilized tourism resource. It can serve as a platform for archaeological research, environmental education, cultural interpretation, employment generation, local economic development, and heritage conservation. The study therefore concludes that a carefully planned, interdisciplinary, digitally supported, and community-inclusive approach can transform Pakistan's caves into sustainable heritage destinations while ensuring that their archaeological, cultural, geological, and environmental values are protected and transmitted to future generations.

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