



# Qanat Tourism Development: A Content Analysis Approach

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## Original Article

Received:

18-Jan-2025

Revised:

01-Mar-2025

Accepted:

05-Mar-2025

Published Online:

12-Mar-2025

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## Abstract

Qanats, as remarkable feats of water engineering and symbols of indigenous knowledge in arid regions, hold a unique position in cultural heritage and sustainable tourism. Qanat tourism, a subset of geotourism, not only examines historical water systems but also provides opportunities to engage with the culture and history of local communities. This study utilizes content analysis to explore the key factors driving the development of qanat tourism. Data were gathered through semi-structured interviews with experts and analysis of relevant documents. The findings emphasize the importance of factors such as infrastructure development, resource provision and financial support, training and awareness, enhancing local culture and indigenous identity, host community empowerment, water resource and environmental protection, tourist security and health, and effective marketing strategies. Additionally, the study identifies key challenges to qanat tourism development, which require strategic attention and planning to address. These insights contribute to managerial decision-making and policy formulation aimed at promoting qanat tourism across diverse regions.

**Keywords:** Tourism Planning, Geotourism, Qanat Tourism, Content Analysis

## Introduction

Geotourism focuses on the identification and use of Earth's resources and natural heritage. This form of tourism encompasses a range of activities, infrastructure, and services designed to acquaint tourists with the scientific, cultural, and aesthetic values of Earth's heritage while emphasizing the enhancement of these values through tourism experiences (Dincă *et al.* 2023; Gupta *et al.* 2024). Geotourism involves the visitation, learning, evaluation, and interpretation of geological features for tourists (Muduli *et al.* 2022) and not only contributes to the economic development of regions but also elevates public awareness of the

importance of natural resource conservation. This branch of tourism strengthens the connection between humans and the environment by integrating geological knowledge with tourism activities.

In this context, as unique heritage sites with geological, cultural, historical, and ecological characteristics, qanats occupy a distinctive position in geotourism and possess significant potential for sustainable tourism planning and development (Moayedfar and Fatemi 2021). Qanats are underground water supply systems developed for water provision in arid regions (Zafeiropoulos and Drinia 2023).

Various studies have provided different perspectives on the origin of qanats. Some suggest that qanats first emerged in western Iran and subsequently spread to the central and other parts of the Iranian plateau, while others indicate that qanats were developed in the eastern and central regions of Iran, primarily through a greater water demand (Ahmadi *et al.* 2010; Semsar Yazdi and Labbaf Khaneiki 2017; Branduini *et al.* 2021; English 2022). Although the origin is debated, it is widely accepted that these systems were first developed in Iran over 3,000 years ago (Hamidi and Bachikh 2024).

This technology gradually spread to other regions and became one of the engineering masterpieces in history (Zafeiropoulos and Drinia 2023). The significance of qanats has been recognized by UNESCO, with eleven outstanding examples in Iran inscribed on the World Heritage List, emphasizing their cultural, social, and environmental importance (Bahraseman *et al.* 2024).

Qanats, with their unique geographical, structural, and cultural characteristics, have significant potential for attracting tourists. Their historical significance, engineering ingenuity, and connection to local traditions further enhance their appeal, making them valuable assets for tourism development. However, despite their historical, cultural, and ecological values, the tourism aspect of qanats remains underdeveloped (Moayedfar and Fatemi 2021). Qanat tourism, as a subcategory of geotourism, provides an unprecedented opportunity to introduce Iranian history, technology, and culture to the world (Mousazadeh *et al.* 2023a). As UNESCO World Heritage sites, qanats can facilitate cultural interaction and knowledge exchange between local communities and international tourists. The existence of kilometers of underground qanats in Iran (Semsar Yazdi and Labbaf Khaneiki 2022; Delfani *et al.* 2021) is an astonishing phenomenon for many tourists, and visiting these

qanats creates an educational and cultural experience while contributing to local economies and heritage preservation.

Despite considerable research on qanats, there has been no comprehensive study to identify the factors affecting qanat tourism development. There have been sporadic studies, but no coherent framework for their analysis. This scientific gap has created a fundamental challenge in planning and policymaking related to qanat tourism. Here, we aim to identify and examine factors affecting qanat tourism development, attempting to provide a comprehensive framework for improving planning and policymaking in this field.

Here, we collect and analyze diverse data from scientific articles, historical documents, and expert interviews through content analysis methodology to achieve this objective. This method organizes scattered information and extracts meaningful relationships between different factors. The main contributions of this research are:

1. Identification and examination of factors influencing qanat tourism development and addressing the scientific gap in this field
2. Identification of existing challenges in the qanat tourism industry
3. Assistance to planners and policy-makers in this domain
4. Provision of practical solutions for developing qanat tourism in Iran

### Literature Review

Geoconservation, aligned with the sustainable and effective utilization of georesources, carries a new social responsibility and primarily focuses on managing the preservation of geological sites that hold significant scientific, educational, touristic, or cultural value (Yazdi *et al.* 2024).

As a branch of sustainable tourism, geotourism

focuses on the use of identity characteristics and natural and cultural heritage resources of a region to familiarize visitors with geological phenomena and local cultures and traditions (Luis Sánchez-Cortez *et al.* 2023). This concept, one of the newest domains in modern tourism studies (Quesada-Valverde and Quesada-Román 2023), has developed to identify, describe, and evaluate geological heritage, and to do so at different scales. Geotourism is more than recreational; it is a strategic approach to sustainable tourism. Although this kind of tourism can act positively to preserve valuable natural and cultural resources, it can be risky to environmental degradation and natural site damage through unskilled governance (Anougmar *et al.* 2024).

Iran's geographical position and climatic diversity give it abundant potential for geotourism development (Yahya Sheibani and Zamanian 2023). Nevertheless, the country is confronted with severe water scarcity (Yousefian *et al.* 2025), and sustainable water resource planning issues have intensified through changing climatic conditions, population growth, and increased per capita water consumption (Mianabadi and Pourreza-Bilondi 2023; Remington 2018).

Qanats are examples of sustainable engineering solutions to water scarcity (Naghedifar *et al.* 2020; Salarian *et al.* 2023; Manuel *et al.* 2018). With about 3,000 years of history (Mirani Moghadam *et al.* 2021), these systems have been used successfully in water distribution and management in arid regions (Cheng *et al.* 2023; Zhou *et al.* 2023) and have been applied in other countries (Fig. 1; Habashian 2011; Mansouri Daneshvar *et al.* 2023)

Qanats are of two types, named after their main locations: mountain qanats and plains qanats. Qanats consist of a series of vertical wells linked to an underground tunnel, which is constructed on the foothills. This system brings groundwater accumulated in underground aquifers to the surface (Yousefian *et al.* 2025), showing considerable engineering ingenuity in early Iran (Naghedifar *et al.* 2020; Salarian *et al.* 2023). According to the Iranian Ministry of Energy, the number of qanats in Iran is about 36,300. The average length of these qanats is about 6 km and the average depth of all shaft wells of a Qanat together is some 4 km (<https://icqhs.org/st/25/>). In terms of quantity and scale, Iran is the richest country in qanats, with the majority concentrated in the arid and semi-arid steppe regions of Yazd, Fars, and Isfahan provinc-



**Figure 1.** Global distribution of qanats (Hamidi and Bachikh 2024).

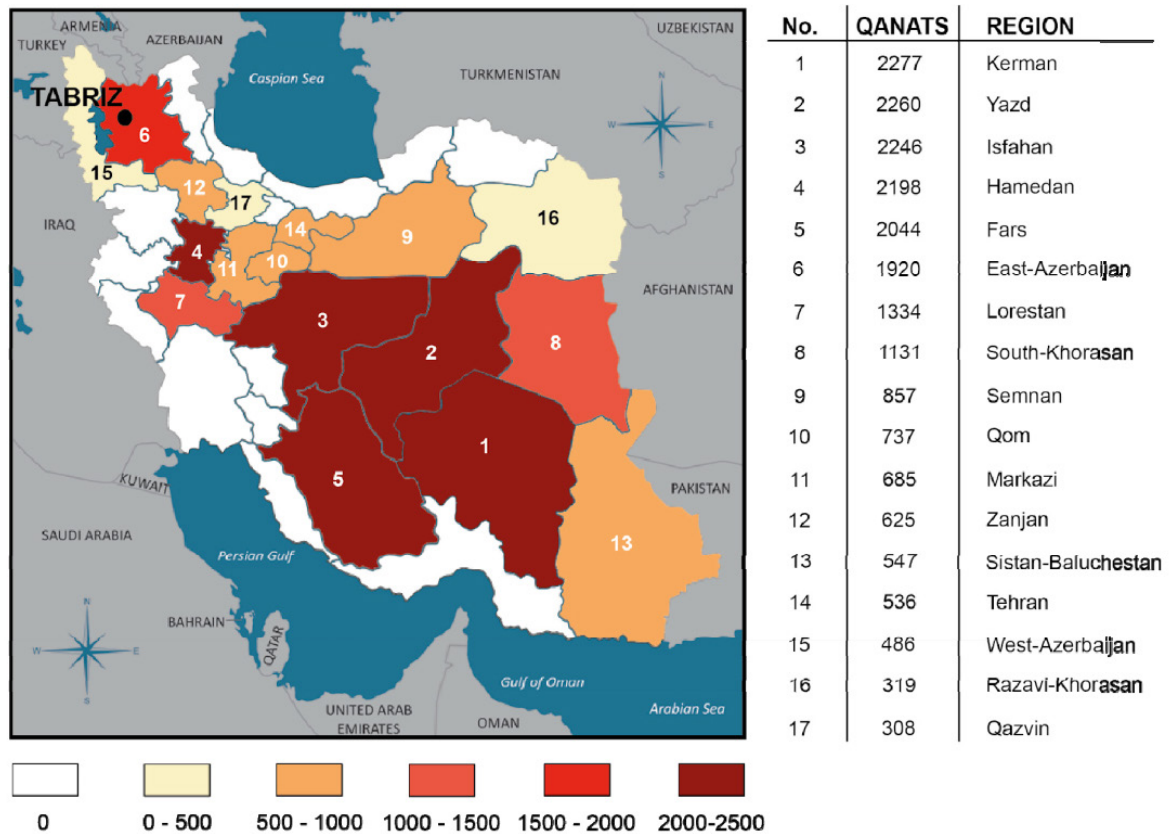


Figure 2. Distribution of qanats in Iran (Branduini et al 2021).

es (Fig. 2). Additionally, several thousand qanats are also found in the highland areas of the Alborz and Zagros mountains, alongside other traditional hydraulic structures (Branduini et al 2021).

In Iran, eleven Persian qanats have been inscribed as UNESCO World Heritage sites, with mills and underground cities being among the most significant underground heritage sites in the country. Each of these qanats features designated tourist routes, allowing visitors to explore the underground canals for extended periods. The specifications of the qanats recognized as UNESCO World Heritage properties are presented in Table 1. The tourist routes in these qanats extend from the Earth’s surface to the depths of the underground canals, continuing until they reach the flowing water. Historically, these routes were used by local communities for water extraction (Mousazadeh et al. 2023b).

Qanat tourism, integrating geotourism and cul-

tural heritage aspects, has significant potential for attracting domestic and international tourists (Moayedfar and Fatemi 2021). This form of tourism, emphasizing sustainability principles, can effectively contribute to strengthening handicraft sales, increasing the utilization of eco-lodges, and creating local employment opportunities. In essence, qanat tourism can serve as a sustainable revenue source for governments and local communities while contributing to preserving and revitalizing this valuable heritage (Mousazadeh et al. 2023a). Nevertheless, this approach is only successful if environmental conditions, local capacities, and good policymaking are considered (Moayedfar and Fatemi 2021).

Studies related to qanats can be categorized into two main domains: natural and human factors. The physical and chemical characteristics of qanats are natural criteria subdivided into technical engineering and geological categories. Technical

**Table 1.** List of Iranian Qanats as UNESCO World Heritage Properties (Mousazadeh et al. 2023b)

Name	Location	Antiquity	Depth	Length	Highlights
Qasabeh	Gonabad, Razavi Khorasan	2500 Year	300 m	33 km	The deepest mother well in the world
Baladeh	Ferdows, South Khorasan	2000 Year	150 m	35 km	Includes 16 Qanats 2 springs
Ebrahim Abad	Arak, Markazi	800 Year	110 m	11 km	It is the only conical Qanat in the world
Akbar Abad and Qasem Abad	Baravat, Bam, Kerman	200 Year	44 m	1100 m	Twin Qanats, These Qanats are twins. The mother well of these Qanats are close to each other, and on the UNESCO Identification of the property and documents, they are on one core and buffer zone.
Zarch	Yazd	3000 Year	23 m	120 km	The longest Qanat in the world
Hasan Abad-E Moshir	Mehriz, Yazd	2000 Year	40 m	71 km	The best water quality, Plaster and salt layers do not form along the channel path
Moon	Ardestan, Isfahan	800 Year	31 m	4 km	It is the only two-story Qanat in the world. On the floors of this Qanat, there are separate streams that never collide with each other
Vazvan	Meymeh, Isfahan	2500 Year	18 m	1200 m	It has an underground dam that can close the outlet and store water for seasons when farmers need more water
Mozdabad	Meymeh, Isfahan	2000 Year	100 m	18 km	The only Qanat with hot and cold water, it looks similar to a cave
Gowhar-riz	Joopar, Kerman	750 Year	50 m	3750 m	The most active Qanat water supply from the fault

engineering criteria, such as channel morphology, qanat depth, and water discharge, play fundamental roles in the planning of qanat tourism. Channel dimension selection can reduce design costs and avoid the need for alteration of the qanat's original structure (Radaei *et al.* 2021). On the other hand, qanat geology, as a primary natural criterion, is necessary for studying and implementing tourism projects (Mousazadeh *et al.* 2023a). Qanat tourism development is also dependent on human criteria. Management, accessibility, and proximity to other attractions are important factors in the success of this type of tourism. Access to attractions is important in attracting tourists, especially in adventure travel (Nepal 2020). The tourism development potential of revitalizing abandoned areas

can be demonstrated by preparing even waterless qanats (Gao and Wu 2017), which can attract tourists. Five main categories of qanat attractions can be based on a wide range of tourist expectations and interests (Carrión and Fornes 2016).

1. Natural Attractions: Qanats present a unique natural landscape through their distinctive natural phenomena, such as calcium carbonate accumulation in tree roots in the lower sections and the presence of diverse fauna.
2. Cultural Attractions: Qanats symbolize Iranian history and culture. The reenactment of ancient ceremonies such as qanat-rain marriages, rain invocation rituals,



**Figure 3.** The phases of the Content Analysis Methodology.

and the display of traditional tools like water clocks connect tourists to the depths of local culture and traditions.

3. **Adventure Attractions:** The geometry of the qanats' intricate galleries is fascinating, and walking and exploring the underground structures in these galleries is a very exciting adventure for the adventure enthusiast.
4. **Technical Attractions:** Tourists interested in technology and engineering are attracted to the demonstration of innovative qanat excavation methods, technical tools employed, and precise calculations used in constructing these systems.
5. **Social Attractions:** Qanats have contributed to the social life of local communities by ensuring equitable water distribution across social classes and facilitating effective resource management. This is particularly interesting to researchers and people interested in social and historical issues.

### Methods

The present study employs a qualitative, exploratory methodology and serves both developmental and practical purposes. Content analysis was used, a method that can identify patterns and hidden themes in qualitative data, integrate scattered information from various sources to create a unified framework, and generate practical knowledge

in areas where existing information is limited and dispersed. Focusing on textual content and interviews, content analysis enables researchers to present more structured and precise information about the research subject.

Content analysis comprises three stages: preparation, organization, and analysis and interpretation (Fig. 3). Initially, relevant data are recorded in text format and prepared for analysis. Then, the collected data undergoes careful examination, including texts and interview data analysis, to identify patterns, relationships, and key concepts. Finally, the analyzed findings are processed, and the main themes are extracted (Elo and Kyngäs 2008). These three stages were executed continuously and systematically to ensure comprehensive data analysis and the presentation of valid, accurate results.

This statistical population comprises scientific articles in Persian and English, credible news sources, and expert opinions on this field. English articles were obtained from Scopus, and Persian articles were obtained from the Magiran, SID, Noormags, and Civilica databases. Articles were selected for analysis if the terms “qanat tourism,” “tourism,” and “qanat” appeared in the title, abstract, or keywords. Irrelevant information was eliminated, and pertinent data were organized for analysis.

Qualitative content analysis coding was applied to the collected data, and secondary themes were

extracted and grouped into primary themes based on semantic relationships. Reliability and validity are two important criteria of credibility and quality of analytical results in qualitative research. All stages of data collection, coding, and analysis were documented with great detail to permit review and replication by other researchers (precise documentation of research stages). Data triangulation was used to verify research validity in that data collected from one source was compared to data collected from other sources (documents, articles, interviews). This approach allowed for the introduction of multiple views into the analysis. In addition, themes were reviewed by specialists and experts to ensure the accuracy and completeness of extracted themes (expert review).

## Results

### Opportunities

We find that the development of qanat tourism requires establishing infrastructure and facilities capable of providing an optimal and sustainable experience for tourists. In this context, the diversity of accommodations, including hotels, ecotourism lodges, and traditional houses, along with the quality of services such as cleanliness, security, and food, are paramount. Additionally, the presence of auxiliary amenities such as restaurants and shops and the architectural harmony of these with the indigenous environment plays a role in preserving the region's authenticity.

We also identified the significance of easy access to qanats. Road quality, efficient public transportation, and adequate parking facilities are crucial in facilitating tourist visits. Alongside these, sustainable transportation methods contribute to reducing environmental impacts.

Environmental protection and tourist safety have also emerged as key factors. Infrastructure related to wastewater and waste management, safety and protection equipment such as warning signs

and emergency routes, and protective measures to avoid degradation of the qanat ecosystem are essential requirements. Reducing congestion and preserving natural and cultural resources is of further relevance for visitor capacity management.

To foster qanat tourism development, securing financial resources and support is crucial. Key is investment in qanat conservation, which involves securing public funding for restoration projects and attracting private investment through incentives such as tax exemptions. Additionally, establishing conservation funds and creating sustainable financial models based on tourism revenue are vital for ensuring the long-term viability of these efforts.

The second factor is support for research and technological innovation. Providing research grants for studies on qanat-related issues and investing in innovative technologies, such as AI for water management, can significantly enhance conservation efforts.

The third factor is offering financial incentives for qanat tourism businesses. Providing low-interest loans and financial support for eco-lodges and local enterprises can stimulate growth in qanat tourism. Moreover, supporting startups and offering tax exemptions for tourism ventures can further boost the sector's expansion.

The final factor is international collaboration and foreign aid. Securing international grants and foreign investment can significantly aid in qanat preservation, while global scientific cooperation enhances knowledge sharing and technological advancements in qanat management.

We find also that training and information dissemination are important in developing qanat tourism and in sustainable heritage preservation. This is especially important in educating local communities as direct stakeholders. Some of the actions that strengthen the role of local communities in

sustainable qanat preservation and utilization are enlightenment, improving local qanat knowledge, and tourism training. In addition, trained specialized local guides who acquire communication skills can better interact with tourists and convey heritage values.

The findings also highlight the need for tourist education. Signs, markers, and specialized guides provide information about qanat history, function, and importance to help tourists become aware of qanat. Furthermore, promoting activities like cur-tailing environmental impact and respecting local culture and communities is also beneficial for qanat conservation and offering a better tourism experience.

Strengthening local culture and identity plays a pivotal role in qanat tourism development. This begins with Designing and Implementing Cultural Experiences, which involves organizing cultural festivals and events related to qanats, such as water or agricultural harvest celebrations. These events, alongside cultural tours enriched with storytelling and guided by locals, offer tourists an immersive experience. Interactive workshops, where tourists can engage in traditional activities like agriculture and handicrafts, further deepen their connection with the local culture.

Preservation and Documentation of Qanat Culture is another essential aspect, focusing on recording traditional methods of qanat construction, maintenance, and usage. This includes producing educational content to preserve indigenous knowledge. Collecting and documenting local stories, myths, and historical narratives related to qanats, and incorporating them into marketing and tourism experiences, further emphasizes the cultural significance of these systems.

Promotion of Cultural Products and Host Community Interaction involves creating and selling souvenirs related to qanat culture, thereby supporting

local craftsmanship. Additionally, providing opportunities for tourists to interact with the local community through workshops and performances strengthens cultural identity and fosters active participation from the host community in qanat tourism.

Host community empowerment is fundamental to sustainable qanat tourism development. Local community participation in tourism management highlights the importance of involving local communities in the planning and management of qanat tourism projects. This includes establishing local councils, fostering a sense of ownership and responsibility, and collaborating with government and private sectors to develop shared management policies. Second, Job Creation and Economic Development focuses on generating economic opportunities for host communities through both direct and indirect employment. Local guides, eco-lodge staff, and service providers benefit from direct employment, while indirect opportunities arise from increased demand for local agricultural products and handicrafts. Furthermore, vulnerable groups, such as women and youth, are empowered by offering low-interest loans and financial support for small local businesses, enhancing their participation in tourism. Finally, Strengthening Cultural and Social Engagement emphasizes the significance of positive interactions between tourists and host communities. This involves organizing cultural events, promoting local customs, and encouraging respectful behavior from both tourists and locals.

Sustainability and Environmental Conservation in qanat tourism is crucial for ensuring the long-term viability of both the heritage and the tourism industry. This includes Conservation of Water Resources, which focuses on sustainable water management, preventing pollution from tourism activities, and restoring damaged qanats with the involvement of local communities and interna-

tional organizations. Additionally, educating both tourists and host communities about the importance of water conservation and the history of qanats is essential.

Equally important is the Environmental Conservation Around Qanats, which aims to protect surrounding ecosystems by preventing habitat destruction and safeguarding plant and animal species dependent on qanat water. Managing waste and reducing pollution are also key components of this effort, alongside promoting sustainable transportation options, such as electric or non-motorized vehicles, to minimize environmental impact.

We can also confirm that tourist safety and security are of particular importance. Ensuring physical safety in qanat areas requires strengthening qanat structures to prevent collapses, utilizing modern technologies for monitoring, and establishing safe access paths equipped with proper lighting, railings, and warning signs. In addition, professional guides should supervise visitors, and restricted areas must be clearly marked to prevent accidents. Health services are equally important, ensuring tourists have access to emergency medical care and first-aid kits, while also providing information about potential environmental risks, such as high temperatures or low oxygen levels in tunnels. It is essential to maintain cleanliness in visiting areas and provide safe drinking water to prevent contamination. Social and psychological safety is vital for tourists to feel secure. This includes the presence of security personnel, systems for reporting issues, and anti-crime measures to prevent theft or fraud. Moreover, local communities should be trained to engage positively with tourists, fostering respectful interactions and preventing any discriminatory behavior. Finally, effective crisis management is necessary, with preparedness plans in place for natural disasters like earthquakes or floods, as well as emergency shelters located near qanat sites. Quick response teams and safe evacu-

ation routes should be available, while regular risk assessments and monitoring can help mitigate potential dangers.

Marketing strategies were also identified as another factor affecting qanat tourism development. The first strategy, Branding and Identity Creation focuses on establishing a unique and memorable image for qanats. This includes promoting qanats as global heritage sites, highlighting their environmental and cultural significance, and presenting local myths and stories related to qanats can help strengthen cultural identity and highlight their historical and cultural importance. Experiential and Interactive Marketing aims to create tangible and emotional connections with tourists by offering hands-on experiences. This includes organizing educational and experiential tours, cultural festivals, and opportunities for tourists to engage with local communities through activities that highlight qanat life and traditions. Content and Digital Marketing leverages multimedia and digital tools to reach a wider audience. This involves producing engaging multimedia content like videos, aerial imagery, and multilingual documentaries. Additionally, virtual tours and augmented reality (AR) technologies allow remote exploration of qanat history, while interactive narratives on social media platforms help amplify qanat stories. Advertising and Marketing Campaigns are designed to raise awareness both locally and internationally. Collaborations with influencers and bloggers, along with targeted advertising campaigns, help promote qanat tourism. Social media campaigns using specific hashtags such as #QanatExperience further enhance online presence and engagement. Finally, Tourist Experience Management focuses on optimizing the visitor experience. This includes designing informative and accessible visitor routes, providing personalized services tailored to different tourist groups, and gathering feedback through surveys to continually improve services and marketing strategies. Table 2 outlines

**Table 2.** Concepts and main categories of factors influencing qanat tourism development.

Concept	Category
<b>Development of Infrastructure and Facilities</b>	Accommodation and Hospitality Facilities
	Accessibility and Transportation Systems
	Protective Equipment and Environmental Services
<b>Resource Provision and Financial Support</b>	Public and Private Sector Investment in Qanat Preservation and Restoration
	Support for Research, Innovation, and Protective Management Technologies
	Financial Support for Qanat Tourism Businesses
<b>Training and Awareness for Qanat Tourism Development</b>	International Partnerships and External Funding Acquisition
	Local Community Training
	Tourist Training
<b>Enhancing Local Culture and Indigenous Identity in Qanat Tourism</b>	Design and Implementation of Cultural Experiences Related to Qanats
	Preservation and Documentation of Qanat-Related Culture
	Promotion of Cultural Products and Host Community Engagement
<b>Empowerment of the Host Community</b>	Host Community Participation in Tourism Management
	Employment Opportunities and Economic Development
	Promoting Cultural and Social Engagements
<b>Water Resource and Environmental Protection</b>	Conservation of Water Resources in Qanat Systems
	Conservation of the Ecosystem Surrounding Qanat Systems
	Physical Security Provision in Qanat Areas
<b>Tourist Security and Health Protection</b>	Tourist Health Services
	Social and Psychological Security of Tourists
	Crisis Management
<b>Marketing Strategies for Qanat Tourism Development</b>	Branding and Identity Construction for Qanat Heritage Sites
	Experiential and Interactive Marketing
	Content and Digital Marketing
	Advertising and Marketing Campaigns
	Tourist Experience Management

the concepts and main categories derived from the research data. These categories have been structured into a comprehensive framework to explain the factors influencing qanat tourism development. The concepts provide detailed insights into each category.

### Challenges

There are many opportunities, as outlined, but also some challenges (Fig. 4):

1. Environmental Challenges and Natural Resource Protection. Qanat Protection: Risk of physical degradation due to tourist traffic, surrounding ecosystem destruction, and environmental problems from increased human activities. Water Scarcity and Climate Change: Reduction in qanat water resources due to climate change, groundwater level decline, and drought threats, potentially reducing tourism appeal.

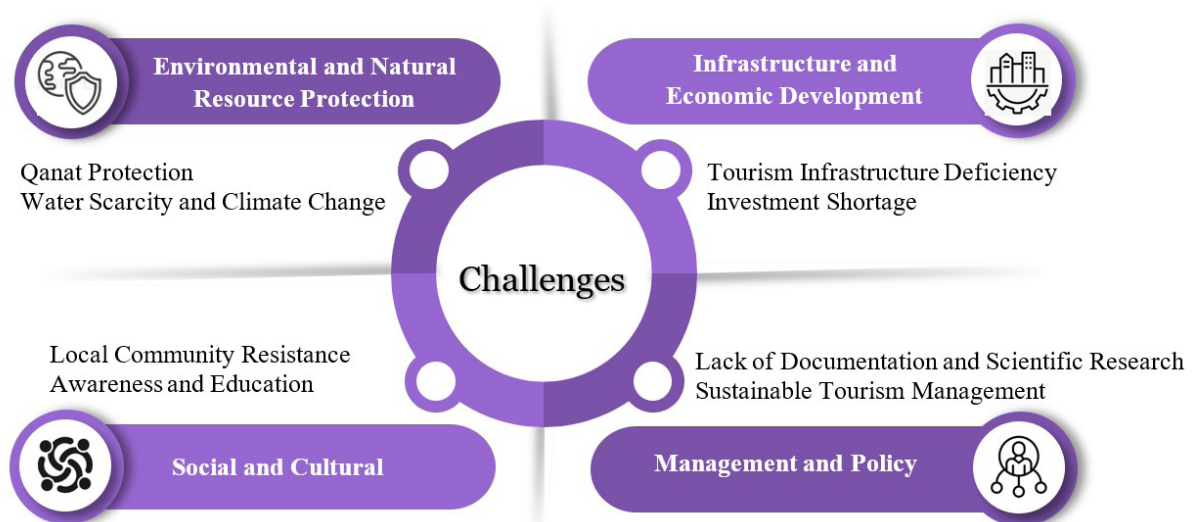


Figure 4. Key challenges to qanat tourism development.

2. **Infrastructure and Economic Development Challenges.** Tourism Infrastructure Deficiency: Inadequate facilities like hotels, restaurants, transportation, and sanitary services are needed to attract tourists. Investment Shortage: Infrastructure development investment needs may be difficult in remote, sparsely populated areas.
3. **Social and Cultural Challenges.** Local Community Resistance: Local community concerns regarding economic and cultural changes from tourist influx and their impact on local lifestyles. Awareness and Education: Insufficient awareness among the host community and indigenous people and tour guides about the importance of qanats and how to present them to tourists.
4. **Management and Policy Challenges.** Lack of Documentation and Scientific Research: Insufficient scientific research and data are needed to improve qanat tourism planning and management, particularly regarding qanat history, architecture, and technical characteristics. Sustainable Tourism Management: Challenge in creating management models that both capitalize on tourism's economic benefits and maintain qanat pro-

tection and natural resource conservation.

## Discussion

Qanat tourism, as part of Iran's cultural and natural heritage, has received significantly less attention from researchers compared to other forms of tourism. Some studies have explored geological aspects and their relationship to geotourism, emphasizing the geological tourism potential of qanats (Omidvar and Khosravi 2010; Moayedfar and Fatemi 2021; Jamshidipour 2022; Dincă *et al.* 2023; Anougmar *et al.* 2024; Yazdi *et al.* 2024); furthermore, certain research has focused on the sustainable management and development of underground heritage (Moazzeni Khorasgani *et al.* 2023; Mousazadeh *et al.* 2023a; Mousazadeh *et al.* 2023b; Yousefian *et al.* 2025) and others have concentrated on the revival of these water systems in urban areas (Habashiani 2011; Manuel *et al.* 2018; Abadi *et al.* 2023; Bahraseman *et al.* 2024). However, there has been limited research addressing the social and cultural dimensions of qanat tourism (Salek 2019; Sheikhi and Pazoki 2021; Vakil 2022). This constitutes a significant gap, as neglecting these dimensions may lead to the erosion of local identity and undermine com-

munity resilience. For instance, In the case of the qanat of Yazd, local community involvement has played a critical role in preserving the qanat system. Several community-driven initiatives and local partnerships have contributed to the preservation and promotion of the qanat as part of the region's sustainable tourism development. These efforts have helped raise awareness about the cultural and environmental value of qanats. Similarly, the qanat of Gonabad, one of the most renowned qanats in Iran, has faced challenges such as environmental degradation and financial limitations. However, efforts have been made by local stakeholders, including government bodies, to address these challenges through environmental conservation programs and the promotion of the qanat as a cultural heritage site, with some success in attracting eco-tourism (Figs. 5, 6). However, efforts to involve the local community in its restoration and management have resulted in successful outcomes, underscoring the importance of community participation in achieving sustainable tourism development. These cases highlight how local communities can contribute not only to preserving cultural heritage but also benefit economically through tourism.

It is essential to adopt a more integrated and systemic approach that takes into account the interactions between the various factors influencing qanat tourism. We find that the development of qanat tourism requires a systemic and multidimensional approach, involving the participation of all stakeholders, including the public sector, private sector, host communities, and research institutions. Collaboration between these groups plays a unique and essential role in developing sustainable tourism models, as summarized in Figure 7.

This research could inspire future studies to examine the challenges and opportunities of qanat tourism more precisely, while also providing a framework for designing management models based

on sustainable development principles. Future research should focus on exploring the dynamic relationships between these factors and their long-term implications for both local communities and environmental preservation. The results suggest that the integration of these factors and understanding their interactions is key to achieving sustainable development in this field, contributing to an enhanced tourist experience while preserving cultural and environmental values. Incorporating all these dimensions into tourism planning ensures that qanat tourism becomes not just a short-term economic activity, but a sustainable and culturally enriching experience for future generations.

### Conclusion and Recommendations

A key objective of this research is to provide practical solutions for qanat tourism development. These include establishing traditional accommodations near qanats, setting up camps with basic facilities, installing restrooms, drinking fountains, and benches along access routes, paving roads, providing clean transportation options like electric cars and bicycles, creating access stations for tourists, and enforcing regulations to protect qanats from damage.

Another key factor is securing financial resources and support. To address this, the following recommendations are made:

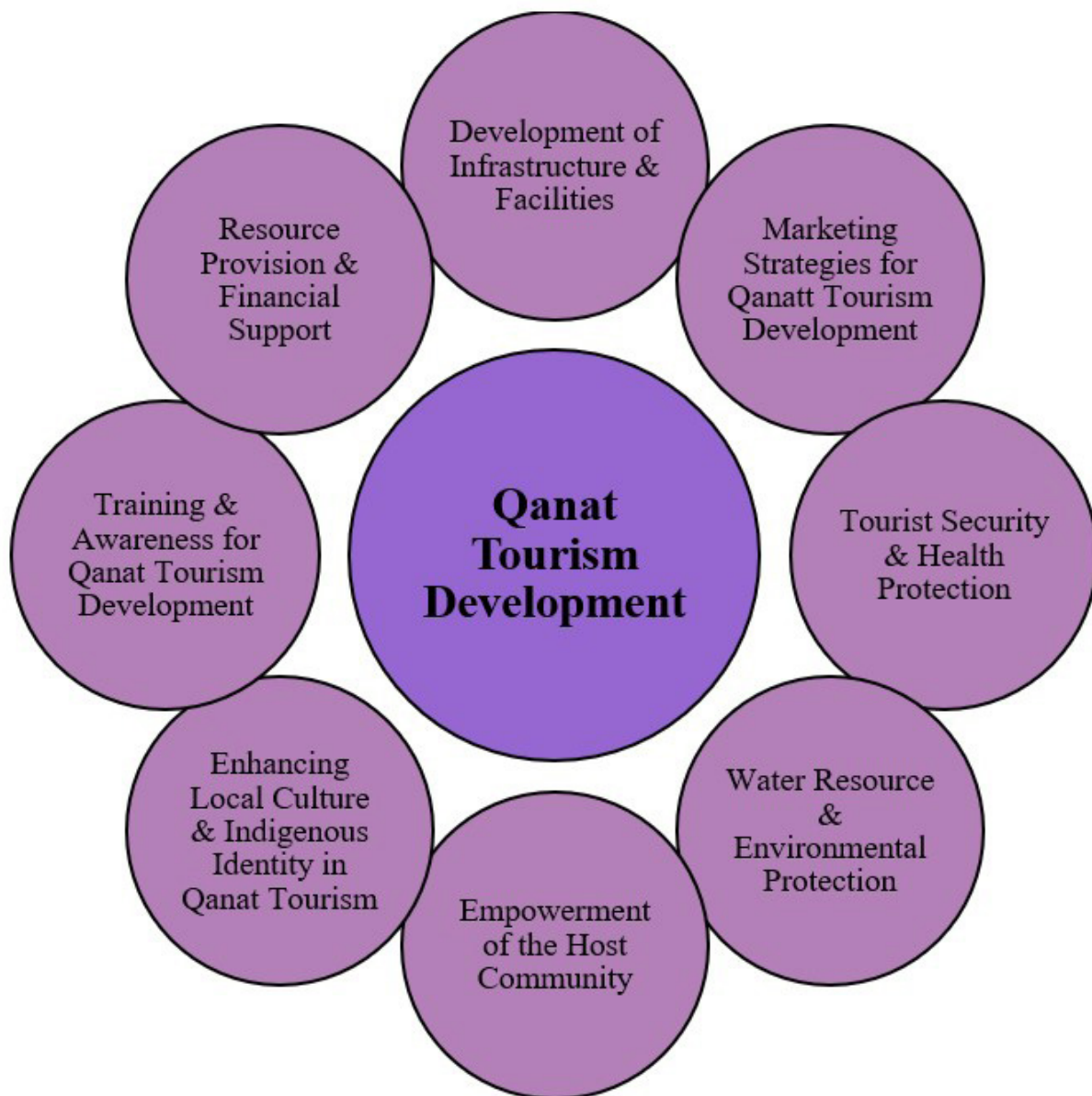
- Providing tax incentives for private investors involved in qanat restoration.
- Establishing dedicated funds for protection projects, with contributions from the government, private sector, and NGOs.
- Allocating research grants to universities and research institutions for qanat preservation, management, and tourism studies.
- Creating innovation hubs to develop new technologies for qanat restoration and management.



Figure 5. A view of Qasabeh Qanat.



Figure 6. A view of Zarch Qanat.



**Figure 7.** Factors influencing qanat tourism development.

- Encouraging researchers and entrepreneurs to propose creative solutions for qanat tourism and preservation.
- Offering low-interest or interest-free loans to businesses in qanat tourism, such as eco-lodges.
- Attracting public micro-investments for qanat restoration and tourism projects.

Training and information dissemination are key

factors in qanat tourism development. Recommended actions include conducting workshops to educate locals on qanat history and cultural significance, producing brochures, videos, and educational materials, and training skills such as tour guiding and eco-lodge management. Additionally, simple information about qanats can be displayed along access routes, and interactive apps or websites can be developed to educate tourists. Organizing qanat-themed tours and cultural festivals can strengthen indigenous culture, while exhibi-

tions and digital knowledge banks can help preserve and promote this heritage.

Empowering the host community is a key factor in qanat tourism development. To achieve this, several measures can be proposed, including establishing local councils for decision-making on qanat tourism, supporting the production and marketing of qanat-related handicrafts, and training local residents as tourism guides. Other important steps include designing programs that allow tourists to engage in local activities, educating children and adolescents about qanat culture, and empowering locals through digital platforms for advertising and selling services and products. Launching online stores for handicrafts and qanat-related products can also enhance local involvement and economic growth.

Operational measures are essential for ensuring the sustainability and protection of qanat water resources and the environment. Key actions include installing water quality monitoring devices, developing coordinated programs for optimal water use across agriculture, industry, and tourism, and implementing qanat restoration projects. Promoting sustainable agriculture through reduced pesticide and fertilizer use is also beneficial. Additional measures include building small treatment plants, enforcing pollution regulations, and launching educational campaigns for locals and tourists. Effective strategies also involve protecting qanat zones, planting native trees, installing warning systems, and strengthening the role of governmental and local organizations in qanat protection. Encouraging community participation through volunteer programs and providing investment incentives can further support sustainable protection efforts.

We also make recommendations to help create a safe and enjoyable environment for tourists. This includes installing warning signs at hazardous areas such as slippery walkways and unsafe qanats. Railings and barriers around vulnerable qanats are

essential for physical protection, reducing the risk of accidents. Additionally, lighting systems along pathways and at qanat entrances improve visibility at night. Surveillance technology can enhance security and prevent crime, while security stations in high-traffic areas allow for rapid emergency response. Preventive measures such as distributing brochures or videos to inform tourists about environmental hazards like snakes, insects, or heat exhaustion are also crucial.

Qanat tourism marketing in Iran can be enhanced through several strategic initiatives. A strong focus on creating distinctive branding elements, such as logos and slogans highlighting the unique features of qanats and their historical and cultural significance, is essential. Emphasizing the UNESCO World Heritage status of qanats, designing specialized tours based on local experiences, and integrating qanat visits with other cultural and natural attractions can significantly boost tourism appeal.

Interactive content, such as videos, infographics, and augmented reality apps showcasing qanat features, along with multilingual brochures, can further strengthen marketing strategies. Organizing cultural festivals with live demonstrations of traditional qanat-related activities, creating interactive museums, and educating tourists about qanat techniques are additional effective initiatives. Utilizing social media, digital marketing, multilingual content, and collaborating with international agencies for qanat promotion can also increase visibility. Other important actions include search engine marketing, publishing tourism content on renowned websites, and collecting tourist feedback to refine services and marketing approaches.

Future research on qanat tourism should address its economic, social, cultural, and environmental impacts. Key areas of focus include analyzing the effects of qanat tourism on local communities' economies and lifestyles, exploring methods

to reduce environmental impact, and developing sustainable tourism management models involving local communities and the private sector. Investment in tourism infrastructure and evaluating the roles of government, private sector, and local communities in qanat management through cost-benefit analysis is also crucial.

#### Conflict of Interest

The authors declare that there are no conflicts of interest associated with this study.

#### Availability of data and materials

The data that support the findings of this study are available from the corresponding author, upon reasonable request.

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