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Sustainable cultural heritage landscape: an imaginary journey inside the veins of deserts

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Introduction: Travel narratives are very attractive sources that examine the destination from the point of view of tourists with different attitudes. A group of studies has been conducted on travel narratives, but this type of analysis has been done very little in Iran despite their potential.

Methods: 11 Persian qanats (PQs) have been recognized as UNESCO World Heritage sites. Visitors who explore the qanats as conduits of the desert have extraordinary experiences that can seem like captivating fiction. The main focus of the current research is on the narratives of tourists who have visited these PQs. Qualitative and narrative analysis methods were used to avoid relying on numerical data.

Results: The study includes 30 participants who had visited the qanats and shared their travel stories. The study findings show that Persian qanats are a distinctive draw for foreign tourists that can leave a lasting impression.

Discussion: The PQs listed as a UNESCO World Heritage property are one of the unique attractions of Iran's tourism, so far its tourism potential has been less noticed, and qanat tourism is a nascent branch of tourism in Iran. The narratives of travelers can be instrumental in promoting this invaluable groundwater engineering heritage.

KEYWORDS

sustainable cultural heritage, sustainable development, water resources development, water resources heritage, travel narratives, Qanat tourism, groundwater engineering heritage, UNESCO world heritage

1. Introduction

Since Alfons Gabriel's famous statement about the experience of traveling to the heart of Iran's pristine deserts, many tourists from all over the world have been curious to visit the desert regions of Iran. Gabriel, who traveled to the Iranian desert three times, believed that "The desert will never let go of someone who once fell in love with it." Indeed, there is a unique relationship between tourism and pristine areas, and numerous studies have been done on the connection between tourism and less developed regions (Ghorbani et al., 2015, 2023a,b,c,d). Each country's tourism industry is shaped by its climate and conditions, resulting in various types of tourism (Ghorbani et al., 2021, 2023a,b,c,d).

The Iranian desert is an extensive and arid land where water and wind erosion have created unusual landforms like Kaluts, Caves, and valleys. In addition to these natural structures, desert natives invented the qanat phenomenon to live in the desert (Bartold, 1971) and have access to drinking water (Yazdi et al., 2014).

In Iran, water has consistently remained the most essential element for production, significantly shaping socio-economic frameworks. Approximately in the year 800 BC, Persians became adept at utilizing technology for harnessing groundwater resources (Goblot, 1979; Behnia, 1988). The architecture of the aqueduct and the provision of cold water in the hot deserts of Iran are fascinating subjects that attract tourists. For many years, the qanat phenomenon has been a crucial means of providing drinking water in the arid desert regions of Iran, where the average rainfall is very low (Ghorbani et al., 2015, 2023a,b,c,d). Qanats in Iran consist of deep and lengthy underground channels, through which water travels several miles from the primary source to reach humans. Moreover, qanats are one of the most vital sources of agricultural water supply in the Iranian deserts. In comparison to other water sources, qanats offer a reliable and healthy source of water, which contributes to enhancing food security. Currently, tourism farms have been established in the Iranian deserts to improve food security, where tourists can purchase organic products while enjoying their stay (Ashtiani and Simmons, 2020). These farms aim to promote sustainable agriculture and offer a unique experience to tourists, who can witness the traditional farming practices of the region. By supporting these tourism farms, local communities can boost their income and enhance their livelihoods.

Foreign tourists who have traveled to Iran to see the structure inside the Persian qanats (PQs) consider them as vital resources of the desert. Tourists consider the canals of the qanats as a way to travel to the depths of the Iranian desert, and when they walk in them, they believe that the difficulty of their construction is equal to the construction of the three pyramids of Egypt (Mousazadeh et al., 2023b). The length of these qanats in the desert of Iran is estimated at 400,000 km (Yazdi and Khaneiki, 2019; Delfani et al., 2020). Of the 41,031 qanats in Iran, 11 PQs have been registered as UNESCO World Heritage sites (UNESCO, 2016a). By publishing images of these PQs from inside the earth in cyberspace and their strange structure, many tourists, under the name of aqueduct tourists, decide to travel to Iran in the post-Corona era. Qanat and sustainable development are also closely linked (De Ruiter, 2020). It is expected that due to the current condition, PQs will become attractive places for tourists, which will have many positive effects and benefits for the desert dwellers of Iran. Encouraging desert dwellers, selling handicrafts, creating employment opportunities for local guides, and increasing the use of eco-lodges are examples of qanat tourism (Mahan et al., 2019).

This study examines the 11 world-registered PQs from the perspective of travel narrative analysis and promotes an edutainment approach in tourism management. The main purpose of this study is to introduce PQs through travel narratives from qanat tourists' viewpoints. Tourists have different and fascinating narratives of their journey into the central desert of Iran. They experienced the story of Jules Verne's journey to the center of the earth or felt like they were reading a fictional novel by Jules Verne (Schweinsberg and Darcy, 2022). Investigation of PQs and their role in tourism management studies is a new subject that has not been researched much. While Naghibi et al. argued about the structure of the qanat, its function, and water quality and presented a comprehensive study on qanat structure

engineering (Sedghi and Zhan, 2020), they did not consider the qanat phenomenon from the viewpoint of tourism management. Khorramrouei and Nasiri discussed visiting the qanat for tourists as a memorable experience, but they did not explore the narratives of tourists (Ebrahimi et al., 2021). Therefore, the present study aims to encourage researchers to pay more attention to the narratives of tourists and their role in tourism management research methods.

This study aims to introduce the 11 incredible Persian qanats registered on the UNESCO World Heritage List, utilizing an edutainment approach. It also aims to familiarize tourism researchers with new topics and qualitative methods in tourism management and showcase the beauty of the Iranian central desert and its water structures. To achieve these goals, we employ the narrative analysis method to analyze the captivating narratives of tourists during their journeys into the Persian aqueduct. As noted by scholars (Haris et al., 2020), travel narratives are essential and fascinating, enabling the development of an edutainment approach in tourism management. The narrative analysis method is advantageous over other qualitative methods due to its ability to present tourists' opinions freely, providing a comprehensive understanding of the destination from their point of view. Narratives are an attractive source for destination studies (Mura and Sharif, 2017).

The current study is unique and timely, as it contributes to filling the gap in the field of tourism management in the PQs. Applying a new qualitative research method (narrative analysis) to introduce the tourism attractions of 11 PQs is a novelty in the current study. Compared to the qanat background literature, the present study can introduce the qanat as a tourist attraction and reflect tourists' opinions about it, while previous studies have mainly examined the opinions of experts (Mura and Sharif, 2017).

The above research questions were designed to explore (1) why PQs are attractive to foreign tourists, (2) how tourists narrate their memories of visiting the PQ, (3) what tour guides think about PQ tourism and its functions, and (4) why collecting and publishing travel narratives are essential in tourism management.

2. Literature review

Qanat is a remarkable feat of engineering by ancestors and an effective method for sustainable water distribution and management (Naghedifar et al., 2020). This water supply method has been extended and evolved in most arid regions of the Iran plateau (English, 1998; Cheng et al., 2023; Zhou et al., 2023) and 34 other countries (Habashiani, 2011). According to Moghadam et al. (2021), Iran is considered the birthplace of qanat due to its unique geographical location compared to other countries, particularly its hot and dry climate, where qanats first emerged and developed/evolved and the evolution of qanats took place about 3,000 years ago. Nevertheless, the geographical origin of qanat is still a subject of controversy, and you cannot take it for granted that Iran is its historical origin. Moreover, the ancient qanats in Oman have been dated at 4,000 years ago (Italian Mission to Oman, 2013, p. 337). The emergence of cultivation for livelihood spending, insufficient natural surface water resources, and the difficulty of transferring water from far main sources to the site point are factors that led to the creation of qanats (Rouhani, 2020). Iran and other nations, such as Iraq, China, Algeria, Syria, and Jordan, are widely accepted as having one of the most common and cost-effective irrigation systems. In addition, the aqueduct serves to prevent destructive floods and increase local participation in water distribution.

Climate change is causing global dry lands to expand (Zhu et al., 2023a,b), posing a threat to global food security (Yao et al., 2020), particularly in Iran (Doulabian et al., 2020; Rahimi et al., 2020; Fazel-Rastgar, 2021). Furthermore, the irrigation of agricultural lands with qanat water is directly linked to food security and sustainability (Mousazadeh et al., 2023b). For over 1,000 years, qanat has been one of humanity's innovations that have had a significant impact on agriculture, irrigation (Bonine, 1996), and the formation of communities, prosperity, and construction, particularly on the Iran plateau (Bensi, 2020). The motivation for humans to devise and use the qanat system in desert regions was climatic changes toward the world getting warmer (Zeppel and Beaumont, 2011). Because Iran has different climatic and geographical environments, mostly arid and semi-arid climates, the need to irrigate cultivated lands led to navigating underground water through the qanat system. Although the technique of constructing qanats was first invented in the North and Northwest of Iran, it was predominantly used by desert dwellers in the central and eastern regions. Throughout history, qanats have played a significant role in these districts, particularly from economic, socio-ecological (Lightfoot et al., 2023), and political perspectives (Manuel et al., 2018). The construction and utilization of qanats in Iran date back to 6,000 years ago in response to water scarcity and extreme drought on the plateau (Delfani et al., 2020). The term qanat was first mentioned in an inscription by Sargon, king of Assyria, in 700 B.C. (Barshan, 2018). The peak of prosperity and digging of qanats dates back to the time of the Achaemenid dynasty (550–330 BC), particularly during the reign of Darius the Great, when this technology was transferred from Iran to Egypt (Sorush et al., 2020). During the Parthian period, this technology was transferred from Iran to China, and then, during the Safavid period, when water scarcity intensified, the digging of qanats peaked again. Almost all of Iran's excavated qanats belong to the last 200 years or, in other words, the Qajar dynasty (Barshan, 2018). Hence, Iran, with the highest number of qanats in the world, has roughly more than 41,031 qanats with a total length of 400,000 km (Yazdi and Khaneiki, 2019). The longest and deepest qanats in the world are located in Yazd province and Gonabad City (Mostafaeipour, 2010).

The simplicity of qanat construction is an art that has undergone less change over the years (Salek, 2019). The three primary internal constituents of PQs are the mother well, wells, and the channel. The ultimate point of each qanat is called "Pishkar," where the mother well is situated. The mother well, which is the deepest well in the chain of vertical shaft wells, is the head of the qanat and the main source of the water supply, at which the underground channel terminates (Figure 1). The deepest mother well in Iran, with more than 300 m depth (Yazdi and Khaneiki, 2016), are located around Gonabad city. In the qanat system, several wells are interconnected by an underground tunnel that conveys the groundwater from headwaters downstream. As shown in Figure 1, the qanat consists of a series of tunnels with varying depths that have been dug from the beginning to the end. The most crucial function of wells is to transfer air into the ground and dredge the water path (Radaei et al., 2020). The other component is the channel containing different vertical wells that transport the water from the mother well area to the outlet point or, in other words, Mazhar. Mazhar is an area located near the village where the qanat reaches the surface after its underground path.

In conclusion, qanat is an innovative and sustainable method of water supply that has been utilized for thousands of years in Iran and other arid regions worldwide. The qanat system has played a crucial role in agriculture, irrigation, and the formation of communities, prosperity, and construction, particularly in the Iran plateau.

2.1. Qanats: structure and function

According to The Iranian Ministry of Energy report in 2018, the number of qanats was 41,031 with a total discharge of 4,531 million cubic meters (Khaneiki, 2019; Moayedfar and Fatemi, 2021). The most significant qanats are located in arid provinces such as Khorasan, Isfahan, Yazd, Kerman, Markazi, and Fars. UNESCO has designated 11 qanats as symbols of ancient hydraulic structures in the world, with each containing noteworthy peculiarities in terms of longevity, length, depth, discharge rate, ancientness, water transmission, and management technology (UNESCO, 2016b). These masterworks have crossed the borders of Iran, and their inscription as the 20th Cultural Intangible Heritage by UNESCO reflects the Persians' dexterity in mastering hydraulic engineering (Ghorbani et al., 2019, 2023a,b,c,d).

2.2. Qanat tourism

Foreign tourists, especially adventurers, travel to Iran to visit unique natural and tourist attractions, such as the Lut Desert World Heritage Site, the valley and desert of Jinn, and the Cloudy Ocean phenomenon (Ghorbani et al., 2019, 2023a,b,c,d). Qanat tourism can play a crucial role in protecting cultural and natural heritage and reviving the economy of less developed regions (Omidvari and Golzari, 2016; Morote et al., 2017). Qanat tourism can actually be considered a subcategory of cultural tourism, which is currently growing in the world (Labaf Khaneiki and Semsar Yazdi, 2015).

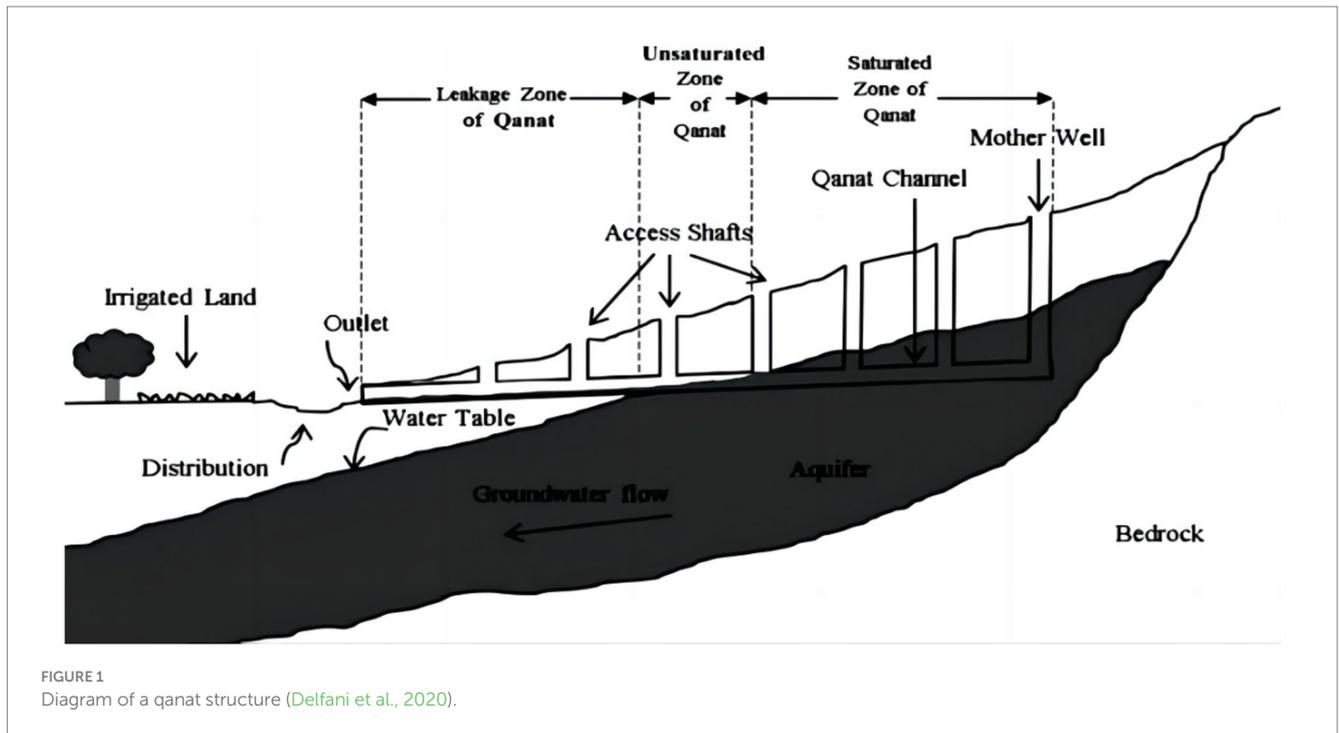
Qanat studies can be classified into two categories: natural and human. The natural criteria of research relate to the physical and chemical conditions of the aqueduct and are divided into two groups: technical, engineering, and geological. The technical engineering criteria, including corridor morphology, aqueduct depth, and qanat discharge, are crucial in tourism planning for the aqueduct. Selecting the appropriate corridor dimensions reduces design costs and the need for modifications and changes to the main structure of the aqueduct (Barshan, 2018; Radaei et al., 2020). The geology of the qanats is another critical natural criterion essential for studying and implementing tourism projects.

Human-related criteria are also vital in qanat tourism, particularly management, access, and distance from other attractions. Access to attractions is a crucial factor in adventure trips (Nepal, 2020). Even waterless qanats can be prepared for tourist visits, highlighting the potential for proper tourism development to revive abandoned areas (Gao and Wu, 2017). The existence of 400,000 km of underground qanats in Iran (Yazdi and Khaneiki, 2019) is a surprising fact for many tourists. Qanat tourism can serve as a new source of income for the government and local people, increase the economic efficiency of qanats, and facilitate their maintenance (Table 1).

3. Methodology

3.1. Study area

The PQ has been a vital component of underground water extraction in Iran since ancient times. It holds a unique place in the country's cultural, social, political, and physical environment, providing a foundation for territorial collaboration and social capital



(Khaneiki, 2019; Zivdar and Karimian, 2020). The structure of PQ dates back to 6,000 years ago, and its technique has spread to other areas of the world over time, owing to the favorable output of qanats (Delfani et al., 2020). The PQ scheme comprises 11 component parts shared across six Provinces (Isfahan, Yazd, Kerman, Razavi Khorasan, South Khorasan, and Arak, see Figure 1), providing an excellent testimony to the practice of supplying arid areas with water to sustain settlements. The role of qanats in the scientific and communal accomplishments of different cultures is crucial, and the name “qanat Civilization” conveys its vital significance for the greater arid area.

At the time of nomination, a management policy and action plan were outlined for the PQs, which will be transformed into individual section management and maintenance plans, including interpretation and tourism management plans (Mousazadeh et al., 2023a,b). Therefore, our study areas for the PQs have been identified in these six provinces of Iran (Table 2; Figure 2).

3.2. Tourists narrative analysis

In tourism studies, the narrative approach is often used to present the current state of information on a given subject, such as tourism in PQs, from a theoretical and qualitative perspective (Perkins et al., 2020). While narratives have been investigated as an object of study, few submissions have employed narrative interpretation as a research tool (Mura and Sharif, 2017). The narrative methodology encompasses a range of approaches and strategies under an umbrella concept (Pasquinelli and Trunfio, 2020), and is suitable for responding to the goals and objectives of research that require a synthesis of subjects. A narrative analysis allows for the coverage of topics that are too broad for focused systematic literature searches perspective (Perkins et al., 2020).

For PQ tourism, a narrative approach is used to firstly analyze the specific capabilities and potentials of each qanat, and secondly, to describe the attractions of qanats and their impact on the local economy, as well as proposals and activities for paying special attention to PQ in tourist studies. Visiting “Persian Qantas” has always piqued the interest of tourists, and this study seeks to understand the structure of the technology used to develop qanats, their relative position in the socio-cultural context of the locals over the centuries, how they were constructed, and how they managed the various difficult stages of construction. Understanding the role of PQs in heritage tourism requires an examination of how qanats operate, their performance (Mousazadeh et al., 2023a,b), and their wonder through narratives.

While various methods and approaches have been used to analyze qanats and heritage tourism sites in Iran (Mousazadeh et al., 2023a,b), this study focuses on the experiences and narratives of visitors as tourists, experts, academic researchers, and local people. This is due to the novelty of the research methodology and topic, and the lack of scripted research or tour guides to rehearse scripted narratives. Therefore, a spatial narrative analysis has been supplemented by thematic narrative analysis and quantitative text analysis. This study takes place within the framework of an interpretative inquiry, which takes into account the nature of experiential evidence as well as the form of interpretation and narration (Ritunnano et al., 2022).

Respondents include professionals, researchers, and locals who have experienced travel, research, and work related to PQs, and interpret PQ narratives based on their experiences and knowledge. The analysis is focused on the premise that readers do not correct the meanings found in each story, but are also actively (re)produced and (re)interpreted (Taragin-Zeller, 2018; Trzeciak and Schäfer, 2021). The end product of this research is what some researchers have termed a “spatial narrative,” which highlights that listening and

TABLE 1 PQs registered on UNESCO World Heritage list, source: (Mousazadeh et al., 2023b).

Row	Name	Location	Antiquity	Depth	Length	Highlights
1	Qasabeh	Gonabad, Razavi Khorasan	2,500 years	300 m	33 km	The deepest mother well in the world, the oldest and most watery qanat in the world
2	Baladeh	Ferdows, South Khorasan	2,000 years	150 m	35 km	Includes 16 qanats, two springs
3	Ebrahim Abad	Arak, Markazi	800 years	110 m	11 km	It is the only conical qanat in the world
4	Akbar Abad & Qasem Abad	Baravat, Bam, Kerman	200 years	44 m	1,100 m	Twin qanats
5	Zarch	Yazd	3,000 years	23 m	120 km	The longest qanat in the world
6	Hasan Abad-E Moshir	Mehriz, Yazd	2,000 years	40 m	71 km	The best water quality, Plaster and salt layers do not form along the channel path
7	Moon	Ardestan, Isfahan	800 years	31 m	4 km	It is the only two-story qanat in the world. On the floors of this qanat, there is a separate streams that never collides with each other
8	Vazvan	Meymeh, Isfahan	2,500 years	18 m	1,200 m	It has an underground dam that can close the outlet and store water for seasons when farmers need more water
9	Mozdabad	Meymeh, Isfahan	2,000 years	100 m	18 km	The second ancient Persian qanat, It looks like a cave
10	Gowhar-riz	Joopar, Kerman	750 years	50 m	3,750 m	The most active qanat, Water supply from the fault

TABLE 2 Persian qanats sites in the world heritage, source: study findings, 2020.

Row	Province	Qanat name
1	Isfahan	Vazvan
		Mozd Abad
		Moon Ardestan
2	Kerman	Ghasem Abad
		Akbar Abad
		Goharriz
3	Yazd	Zarch
		Hasan Abad-e Moshir
4	South Khorasan	Baladeh Ferdows
5	Razavi Khorasan	Qasabeh
6	Arak	Ebrahim Abad
Total	6	11

narratives are powerful methods to introduce and showcase the tourism potentials and capacities of World Heritage sites, especially those that have been neglected, such as PQs (Mousazadeh et al., 2023a,b). It is worth noting that PQs have been registered as Iran's Twentieth Heritage at the 40th UNESCO World Heritage Summit (Figure 3).

3.3. Data collection and participants

To identify the tourism potential and capabilities of PQs in this study, the authors utilized the narratives and memories of

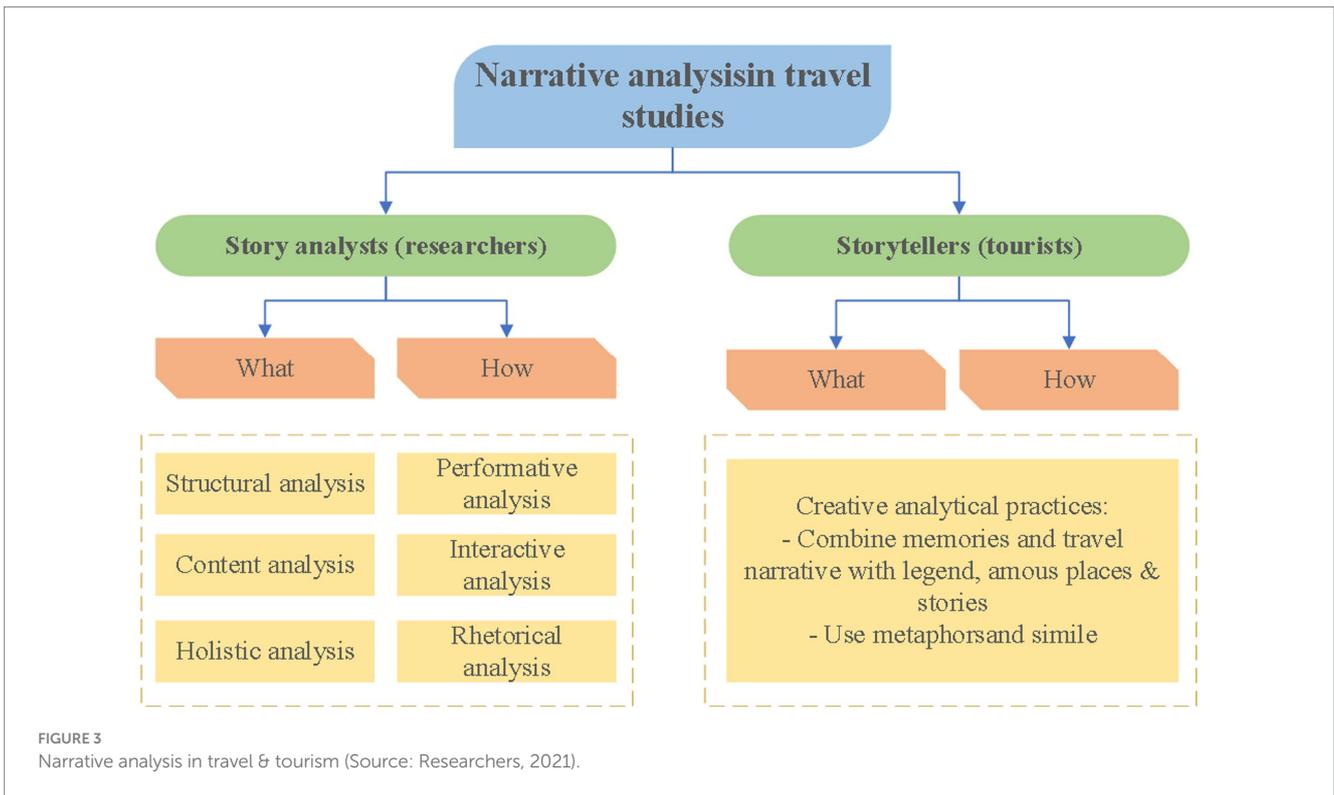
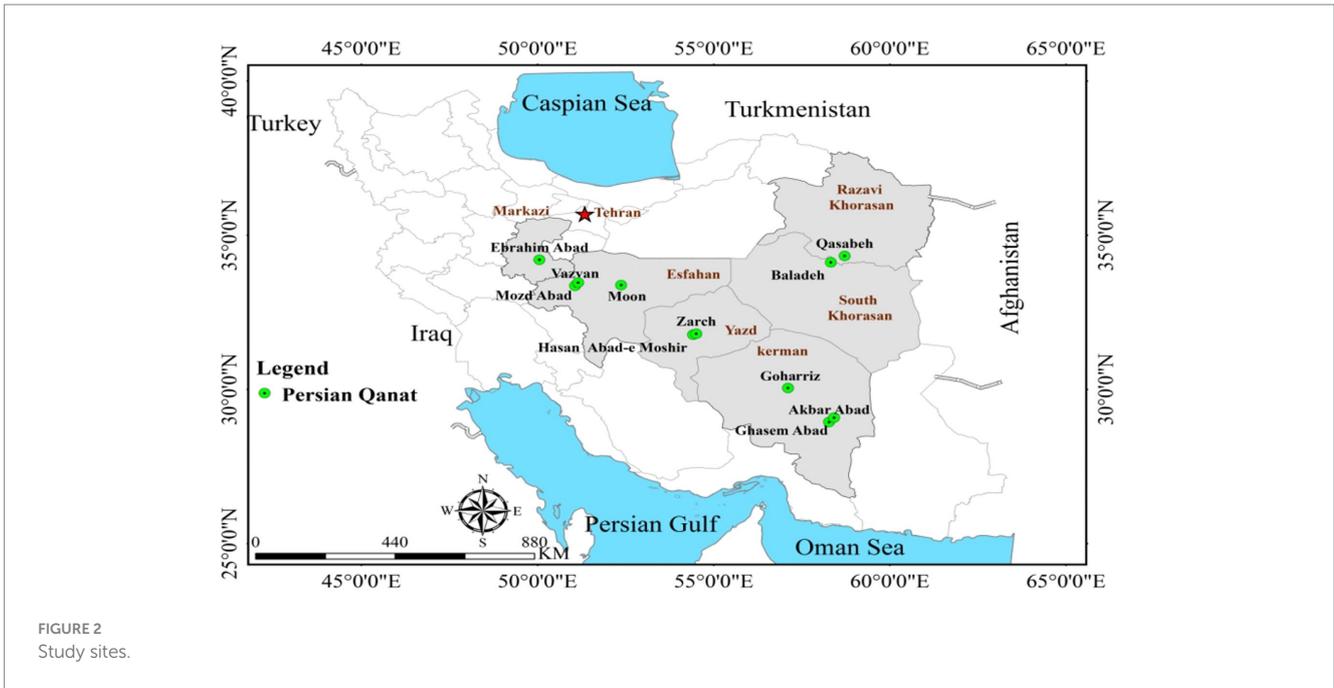
participants, as recent tourism studies have emphasized the importance of this technique (Mura and Sharif, 2017). Pure narrations and travel experiences are particularly significant in tourism studies, especially for unique and rare areas. Hence, the narrations of those who visited the aqueducts formed the basis of the research analysis.

After consulting with experts on the world heritage of PQs, 30 participants were selected for this study, including qanat tourists and local Moghannis.¹ The selection criteria for tourists were individuals who had visited each aqueduct more than once. To showing geographical location of PQ sites in six provinces, GIS software was used, and photography was employed to showcase the capabilities and wonders of each qanat.

It is worth noting that qanat tours usually employ a local person in the area, known as a "Moghanni," to prevent damage to the qanats and to prevent tourists from getting lost in the qanats. Due to challenges and problems in the research process, as well as the COVID-19 pandemic that online media it became an integral part of tourists' lives (Ghorbani et al., 2023a,b,c,d), specialized online meetings were held between research members, officials, and PQ experts to determine the best solutions for each section.

Through this study, the authors aim to provide a deeper understanding of the tourism potential and insight of PQs. By filling the gap in previous studies, this research seeks to shed light on the unique cultural, social, and physical environment of PQs, and their role in supplying water to sustain settlements in arid areas (Table 3).

¹ Moghanni is someone who works on the PQs and is known as a local specialist of qanats and dug and excavate the qanats. From these people, pure and special information about PQs can be obtained.



4. Results and discussion

4.1. Persian qanats tourism

In order to ensure the preservation of the technical, cultural, and historical values of PQs, we propose adding a new function to qanats that would guarantee their protection. One such function is the development of tourism in the qanats (Labaf Khaneiki and Semsar

Yazdi, 2015). By developing the areas where qanats are located and generating tourism revenue, the protection of qanats can be justified (Labaf Khaneiki and Semsar Yazdi, 2015). Additionally, the introduction of qanats as a new attraction can help to promote tourism in the regions (Charloux et al., 2018; Ebrahimi et al., 2021).

Qanats represent an environmentally friendly system that embodies unique technical knowledge and engineering heritage. The PQ's environmentally friendly perspective is used to describe PQs as

a system that aligns with principles of environmental conservation and sustainability (Mahan et al., 2019). Due to their environmentally friendly characteristics such as sustainable use and preservation of water resources, reduced energy consumption, sustainable cultural and historical heritage (Mousazadeh et al., 2023a,b), and minimal environmental disruption, PQs serve as an attractive tourist destination for visitors worldwide who are interested in sustainable and heritage tourism. The structure, tourism route, and map of PQs are presented in Figure 4.

4.2. Qasabeh gonabad qanat

In 2016, a short clip of the Qasabeh qanat of Gonabad captured my attention, sparking a journey to explore the wonders of “Persian qanats.” The initial destination was the Qasabeh qanat of Gonabad. Upon arrival in Gonabad, the author traversed the city’s agricultural lands, which have been irrigated by the qanat water for centuries. The Qasabeh qanat stands as a masterpiece of engineering both in its historical context and in the present day, evoking a growing admiration with each new discovery. This qanat can be perceived as a living organism that has persevered for centuries with the assistance of the locals. Notably, it holds the distinction of being the world’s oldest qanat with the largest Mother Well. The observed rise in foreign tourists visiting the qanats in recent years, as witnessed by the author in their capacity as a tour leader in Iran, serves as a testament to the remarkable characteristics of the Qasabeh Gonabad qanat. Undoubtedly, it ranks among the most extraordinary man-made phenomena, symbolizing humanity’s harmonious coexistence with nature.

A local tour guide once said, *"Have you ever thought that among all these attractions, there might be a place where the blood in your veins would freeze at the thought that it was made by genii or ghosts? I am talking about the Qasabeh Gonabad qanat in Iran! Our elders always said that the construction of this aqueduct at this depth could not be done by the son of Adam, and we have no doubt that this aqueduct was built by forces beyond human beings. It is not without reason that a French researcher named Henri Goblot, in describing his encounter with the Qasbeh aqueduct in the language of praise and mysterious wonder, refers to this aqueduct as a strange and, of course, engineering construction. They have had superhuman strength!"*

Furthermore, a farmer who irrigates their land with qanat water said, *"The farm that I set up with my family members is completely irrigated with qanat water. Throughout the year, many tourists come here to purchase our products, and we even ship products to those who cannot visit. These tourists often claim that the products taste better because they are irrigated with qanat water. We have applied for the establishment of a tourism farm and hope to expand our business."*

4.3. Qanat of baladeh

Baladeh qanat in Ferdos holds the distinction of being another PQs registered in UNESCO. The visit to this site took place during autumn, the season when pomegranate gardens are harvested in Iran.

Ferdos, known for its exceptional pomegranates, provided an opportunity to savor the fruit while engaging in conversations with local farmers regarding the qanat. Notably, the water originating from Baladeh qanat irrigates the gardens in this region. While en route to the qanat’s fountain, a pause at a nearby residence facilitated discussions with workers who shared intriguing stories and even offered a glimpse of an operational watermill powered by qanat water. Recognizing the qanat’s significance in the agricultural sector and the regional economy, the Baladeh Ferdos qanat symposium was convened in June 2009, following the suggestion of colleagues.

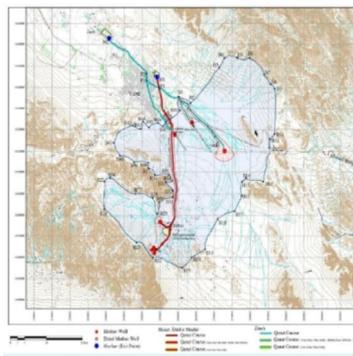
One foreign tourist shared their experience, stating, *"Before traveling to Iran and visiting its qanats, I had no mental idea about it. I entered the qanat with local guides. It was as if the walls were talking to me, as if I wanted to sit and watch for hours. The sound of water, the sound of water! It is impossible to believe that such cold water exists just a few meters below the very hot surface of the earth. I would like to travel there again"* (Male, Baladeh qanat tourist, August 2020).

Furthermore, *"Agricultural lands in the region are mainly irrigated by Baladeh qanat, which is one of the most significant sources of agricultural water supply in the region. Saffron lands are irrigated with water from qanat and motor pumps, and Baladeh water in Ferdows. Saffron requires fresh water, so farms that are irrigated by qanat and spring water also have good yield and longer life."*

4.4. Ebrahim abad qanat

This qanat features a unique well that holds exceptional significance. While walking near the qanat’s exit point, a stop at a local grocery store provided an opportunity to inquire about the UNESCO nomination and gather additional information. The friendly and enthusiastic response from an elderly salesman revealed that in the past, the water level was even higher, and the entire population took responsibility for maintaining and cleaning the underground qanat.

During the scorching summer, a journey to Tehran was necessary to greet tourists. En route from Arak to Qom, a village called Ebrahimabad captured our attention with its 1,000-year-old qanat. Lunch was arranged in this village, chosen by my colleagues and me. Upon arrival, it became evident that this qanat comprised a main branch and two sub-branches. The construction of the main branch was guided by the locals’ knowledge and understanding of PQ technology. Since its inception, it has provided essential water for agriculture and drinking purposes to the inhabitants of the ancient village of Ebrahimabad. The 11-km-long qanat originating from the mother well played a pivotal role in the establishment of a rural town. As we journeyed along the aqueduct, we were continually amazed and captivated by the various interconnected components, such as water storage facilities, baths, and an exceptionally innovative water distribution system. A local guide and Moghanni shared their experience, stating, *"I fastened my waist, knowing that I had an adventurous journey and a very difficult path ahead. Believe it or not, only 311 wells have been built along the main course of this aqueduct. The walls of the wells are all hydrous, and the mother well is also aquatic and falls to the bottom of the well with a strange sound. The fear of this well is due to its conical shape, in which I am just suspended without*



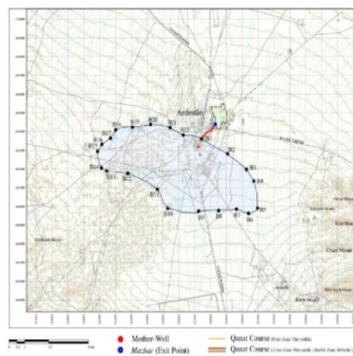
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Mazhar Zarch



Tourism route



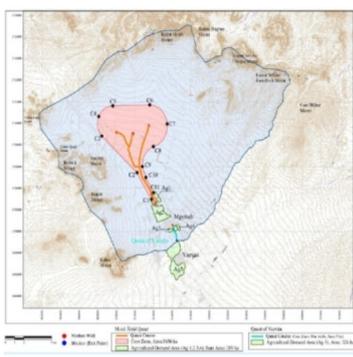
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Mazhar Moon



Tourism route



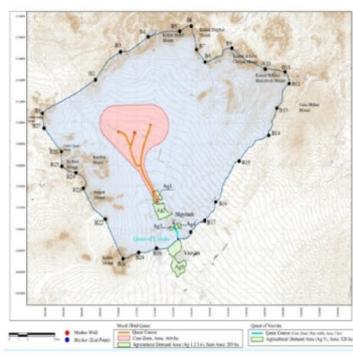
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Mazhar Mozd Abad



Tourism route



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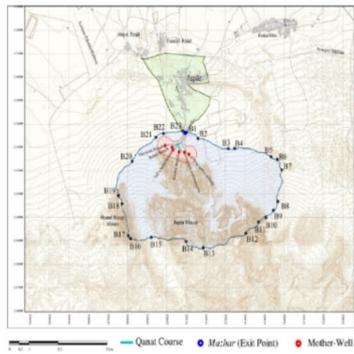


Mazhar Vazvan



Tourism route

FIGURE 4 (Continued)



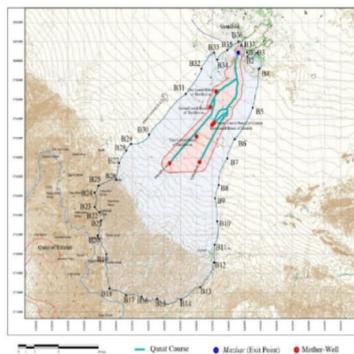
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Mazhar
Gowhar-Riz



Tourism route



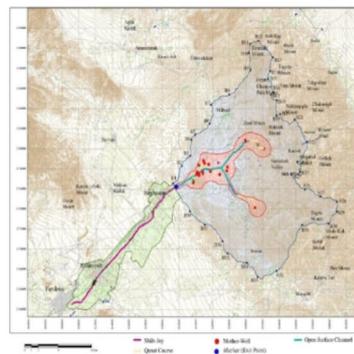
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Mazhar
Qasabeh



Tourism route



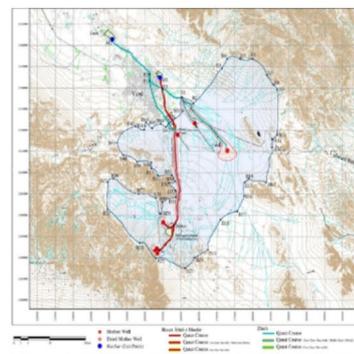
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Mazhar
Baladeh



Tourism route



Buffer zone



Mazhar
Hassan abad Moshir



Tourism route

FIGURE 4 (Continued)

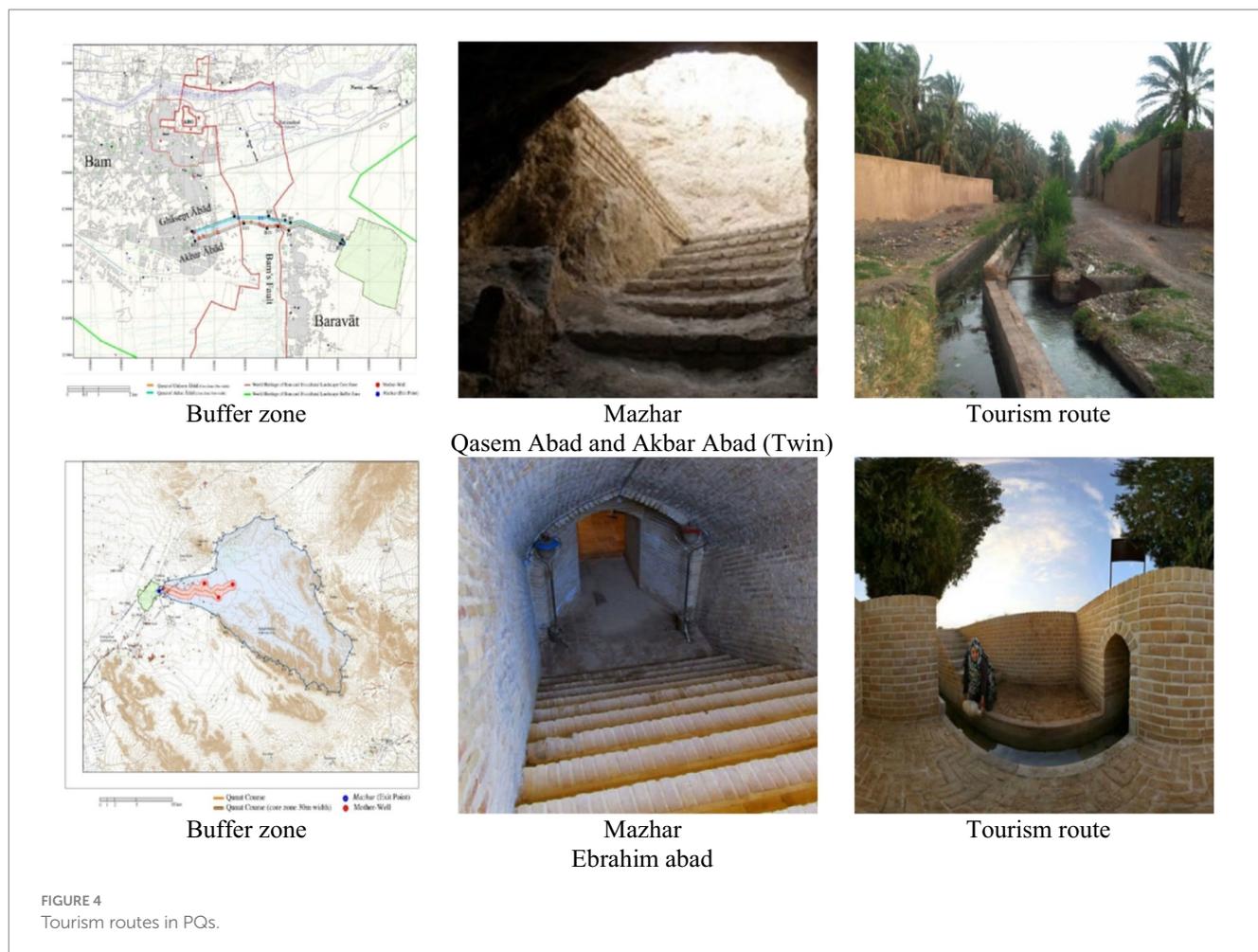


FIGURE 4
Tourism routes in PQs.

access to the walls, and I can see nothing but the terrible sounds of water and darkness. Ebrahimabad qanat is an Iranian underground architectural wonder that must be seen.”

Furthermore, “qanats in this area have long been used for agriculture and crop irrigation. With proper planning and management of the water resources of qanats in this area, in addition to attracting tourists, it is possible to ensure the food security of tourists who visit the area. Many tourists take the water of these qanats with them when they arrive and buy fruits and vegetables that have been cultivated with the water of the qanat, which serves as evidence of this claim.”

4.5. Qanats of qasem abad and akbar abad

The water sourced from the two young qanats in Bam serves the renowned palm gardens of the region, known for their date production and exportation to other countries. Upon reaching the exit points of these qanats, a gathering of children and women surrounded the area. The children were engaged in playful activities and splashing in the water, while the women were occupied with carpet washing.

During the return journey from Goharriz, a visit to Baravat was arranged upon the request of tourists and colleagues. The purpose was to witness the twin qanats of Akbarabad and Qasemabad, which earned their registration due to distinctive characteristics such as their

relative youth (approximately 200 years old), being twin structures, and maintaining a consistent water supply. The discovery of the mother wells of these two qanats in close proximity to each other (approximately 100 m) revealed that their paths ran parallel for a distance of 5 km. The manifestation of these adjacent qanats in Baghsahr Baravat has earned them the moniker “twins.” The twin nature of the Akbarabad and Qasemabad qanats signifies the historical and contemporary interaction, cultural cohesion, and social dynamics among the water owners, contributing significantly to their global recognition by UNESCO. The square cross-section of the qanats stands out as a notable feature, distinguishing them from other qanats with elliptical or circular cross-sections. This architectural characteristic provides evidence of their origins dating back to Zoroastrian times.

A formal leader and accommodation provider shared their insights, stating, “The abundant tourism potentials in Yazd, primarily cultural tourism and qanats, have attracted many tourists to these areas. Locals situated along the qanats have taken advantage of this opportunity to become economically dependent on the hospitality services required by tourists (e.g., local food, accommodation rentals, local leaders, and local products). Since villages that have the phenomenon of qanats depend on tourism, comprehensive plans must be made to recover tourism and improve the economic situation of local communities. Tourists can provide

TABLE 3 Participant profiles of narratives.

Participant demographics	Narrative interviews	Participant observations	Qanat	Row
Female, Iran, 43 years old	2	PQ tourists	Qasabeh	1
Male, Hungary, 26 years old				
Male, Iran, Gonabad, 29 years old	1	PQ tour guide		
Male, Iran, 62 years old	2	PQ tourists	Baladeh	2
Male, Iran, 36 years old				
Male, Iran, Ferdows 29 years old	1	PQ tour guide		
Male, Pland, 27 years old	2	PQ tourists	Zarch	3
Male, Iran, 41 years old				
Female, Iran, Yazd, 34 years old	1	PQ tour guide		
Female, Canada, 47 years old	2	PQ tourists	Hassan Abade-M	4
Female, Canada, 21 years old				
Male, Iran, Mehriz, 33 years old	1	PQ tour guide		
Male, Iran, 52 years old	2	PQ tourists	Ebrahim Abad	5
Male, Iran, 26 years old				
Female, Iran, Arak, 34 years old	1	PQ tour guide		
Female, Iran, 45 years old	2	PQ tourists	Vazvan and Mozd Abad	6
Female, France, 31 years old				
Female, Iran, Isfahan, 35 years old	1	PQ tour guide		
Male, Iran, 67 years old	2	PQ tourists	Moon	7
Male, Iran, 26 years old				
Male, Iran, Ardestan, 34 years old	1	PQ tour guide		
Male, Germany, 32 years old	2	PQ tourists	Gowhar-Riz	8
Male, Iran, 53 years old				
Female, Iran, Joopar, 37 years old	1	PQ tour guide		
Female, Iran, 30 years old	2	PQ tourists	Ghasem Abad and Akbarabad	9
Male, Spain, 41 years old				
Male, Bam, 36 years old	1	PQ tour guide		
Male 5, Female 3	8	Experts and Tourism officers		10
	35	Total		

economic hope at both the regional and local scales for the local residents."

4.6. Qanat of zarch

Yazd province, located in desert and arid regions, relies heavily on the Zarch and Hasan Abad-e Moshir qanats, without which it would be challenging to envision life in Yazd or Mehriz. The importance of the Zarch qanat is reflected in the UNESCO registration of Yazd city, which owes much of its existence to this particular qanat. Thankfully, the qanat is well-preserved and cherished by the authorities and residents of Yazd. Notably, the Zarch qanat boasts the longest underground tunnel among all qanats worldwide, making it a remarkable site to explore.

Following the visit to the Akbarabad and Qasemabad qanats, a journey to Zarch in Yazd province ensued due to its proximity to Yazd

city. This qanat, over 3,000 years old, stretches across a distance of 100 km and encompasses 2,115 wells. Of particular interest was the discovery of some sections of the aqueduct's rods at the site of the Yazd Grand Mosque. This finding suggests that the aqueduct predates the arrival of Islam, and the mosque was constructed in close proximity to the qanat. These rods were utilized to fill a large water reservoir beneath the mosque, enabling worshipers to perform ablutions using the qanat's water through a stream. This functional feature remains in operation to this day. The walls of the aqueduct bear resemblance to the pyramids of Egypt, evoking a sense of awe that is sure to captivate tourists.

An officer in the Ministry of Cultural Heritage, Handicrafts, and Tourism shared their insights, stating, "*In recent years, we at the Tourism Organization have received numerous requests for creating tourism businesses. Most of these requests came from local people who had received loans to establish eco-tourism resorts around the qanats. We have signed hopeful contracts with banks to expedite*

the process of granting loans to applicants. The Tourism Organization supports projects that boost the economy of local communities and encourage people to pursue entrepreneurship and self-employment."

4.7. Hasan Abad-E Moshir qanat

The Hasan Abad-e Moshir qanat of Mehriz flows through a famous garden named Bagh-e Pavlanapour, which is also registered with UNESCO. One notable aspect of the qanat course is that it feeds Bagh-e Pavlanapour, making it the best location to appreciate the qanat and the Garden together. If you are seeking to witness a qanat in the garden, be sure to visit the Hasanabad aqueduct.

On the second day of our visit to Yazd province, we accompanied a local leader to see the Hasanabad qanat. In our opinion, each qanat has its unique characteristics. One of the interesting features of this qanat, which we encountered during our trip to Yazd, is that it does not have gypsum and salt layers along its route. This has resulted in the water of Hasanabad qanat retaining its original quality without any salts, such as calcium, sodium, and magnesium, as it is transported to settlements.

"Accessibility to qanats is crucial for tourists, especially foreign tourists. A trip to the qanats can be a complete, enjoyable, and relaxing adventure, or it can easily turn into a bitter memory. The outcome depends on the preparation before traveling to the qanat attractions. Tourists should be aware of the dangers of traveling to the qanats in summer and winter, be familiar with the principles and skills of rescue in the desert. Although tourist tours to the PQs are licensed by the General Directorate of Cultural Heritage, Handicrafts, and Tourism, sometimes entry to these areas is dangerous for tourists. Hence tourists must have travel information, equipment for qanat tourism, and receive the necessary training," explained a PQs tour guide in March 2021.

4.8. Qanat of the moon

A 1-day trip was undertaken from Tehran to Ardestan with the intention of visiting the qanat. Upon arrival, a descent of approximately 6 m was made via stairs, leading to a tunnel where pure water flowed gently. A particularly intriguing moment occurred when we encountered a hatch, which, upon lifting, revealed another water tunnel approximately 10 m below us. To our amazement, we found ourselves on the second floor of the qanat, with the other tunnel situated beneath us. This remarkable qanat stands as the only two-story qanat in existence, with no mixing of water between the two tunnels. Presently, this ancient engineering marvel serves as a popular tourist attraction, showcasing a fascinating example of ancient engineering principles.

During the visit to this aqueduct during the summer season, it was observed that the water from the upper qanat possessed a better, sweeter taste and was cooler compared to the water from the lower qanat, which was heavier and warmer during this time of year.

"A two-story qanat! In my opinion, it is the strangest qanat structure in the world, where the water from the upper and lower qanats moves independently, without mixing. It was the strangest water structure I had ever seen. The Moon's two-story aqueduct is one of the best examples built in the heart of the Iranian desert. Its unique wonder, being built in the heart of the desert, was a decisive reason for me to recommend it to my colleagues and friends," expressed a male foreign tourist from Canada.

4.9. Mozd abad and vazvan qanats

On a winter night, 2 months ago, a decision was made to visit the Vazvan and Mozdabad qanats in Meymeh City, Isfahan province. Arriving in Meymeh city on a Friday morning via an Isfahan bus, transportation was promptly arranged to visit these qanats, which were situated in close proximity to each other. The utilization of underground dam technology in the Vazvan and Mozdabad qanats marked a significant breakthrough in engineering construction during their respective eras. The vital role played by these qanats in the region's economy is evident, as the local population would face considerable challenges in their absence.

Upon concluding the visit to these qanats, a return journey to Tehran was made, followed by a visit to a local shop in search of a Meymeh souvenir. It was there that an encounter took place with a young man and his brother, leading to an exploration of other attractions in Meymeh, spanning approximately 5 h. The Vazvan aqueduct stands as an extraordinary and historically significant structure. This fact has been confirmed by cultural heritage experts and Japanese UNESCO specialists. Notably, along a section of the qanat, above the qanat dam, two underground cracks (known as Kerr in the local language) are present. These cracks serve as channels for transferring the 40 L of water stored behind the dam for a duration of 120 days, from the 10th of Azar to the 10th of Farvardin in the following year, into large underground reservoirs. Subsequently, with the opening of valves installed in the dam, the stored water is gradually directed back into the consumption cycle with the assistance of gravity. The Vazvan qanat dam, recognized as Iran's primary groundwater dam, holds significant importance within Isfahan province. For detailed insights about this dam, a book authored by [Safinejad and Dadras \(2000\)](#) provides comprehensive information.

A tourism psychologist affirmed that "The quarantine and crisis caused by Covid-19 have certainly affected the health dimensions of tourists who are in contact with nature. Therefore, it seems that the mental health of tourists should be strengthened, improved, and refreshed. Walking in the qanats and seeing beautiful phenomena such as the qanat systems, canals, and mother walls of qanats can undoubtedly improve the mental health of tourists. This is what the World Tourism Organization calls the Restart and Reopening tourism. She also stated that walking in the qanats can have a direct and positive effect on the mental health of tourists," shared a female tourism psychologist from Hungary in February 2021.

4.10. Qanat of Gowhar-Riz

During a subsequent visit to the qanat, a deep exploration was undertaken in the company of a friend and one of the authorities, evoking a distinct and unfamiliar sensation. The experience of being immersed in the depths of the earth, where all light dissipates into absolute darkness, is difficult to fathom. This profound feeling was shared by my friend and me when our guide turned off the headlights. Although it has been approximately 2 years since my last visit to the qanat, the desire to relive that experience remains strong. The Gohariz qanat holds immense significance in the economy of Joopar and has been a destination for renowned adventurers. When planning a trip to Iran and Kerman, it is highly recommended to include a visit to this qanat. As I descended the stairs and caught sight of the faint glow from a flashlight illuminating the crystal-clear water, a hushed silence permeated the qanat, and our journey continued. This qanat stands as a masterpiece, testament to human intellect and resourcefulness. Dating back to an era when myths and legends were woven around it, there was a belief that a white blind fish guarded the aqueduct, and encountering it would result in death. Given its historical significance, economic, cultural, and social value, this aqueduct is deserving of recognition as a world heritage site. It is noteworthy that the water of the Gohariz qanat flows from a fault in the earth.

A PQ tourist shared, "As I went down the stairs, I could see the light of my flashlight, and the fishes appeared when the light shone on the clear water. Yes, fish, you can see fish there. I continued on my way, which is in the depths of the earth. This aqueduct reminded me that this is a masterpiece and a sign of human intelligence and ingenuity that has been able to lead human beings to live in the heart of darkness. I had read travelogs and books written about it many times, but seeing the aqueduct up close, I realized that it was not without reason that Smith introduced this aqueduct as his first love."

The journey to the PQs presented a fascinating opportunity for exploration, providing valuable insights. This experience proved to be highly rewarding, and it is anticipated that readers will share the same sentiment upon delving into this paper and embarking on their own journey. Upon the completion of the expedition to the PQs, a realization emerged that highlighted the constructive interaction between humanity and nature throughout history. The Iranians' exceptional ingenuity and innovative approaches in harnessing water resources in an environmentally friendly manner allowed our ancestors to coexist harmoniously with nature. Their continuous enhancement of innovative skills enabled them to overcome the challenges posed by nature, employing gravity-defying technologies that shaped civilizations in their surroundings. What lessons can be gleaned from their research and development of qanat construction techniques that may prove beneficial for our future? To truly appreciate the PQs, a personal visit is imperative. Therefore, an invitation is extended to embark on a journey to witness Iran's PQs firsthand. Each of these qanats possesses its own unique narrative and offers distinct experiences, rendering it difficult to compile a comprehensive list or provide specific names. Each one is a marvel in its own right.

Regarding the limitations of the research, it is necessary to mention two points. First, the lack of cooperation from tourism officials on several occasions disrupted and slowed down the research

process. Second, there was a lack of research background related to qanat tourism in Iran and internationally. This means that PQs have not been studied from a tourism perspective, which was influential in the research process. This emphasizes the importance of research innovation and novelty, making this research the first scientific study on PQs tourism. The current study brought a fresh approach to the exploration of tourism attractions in 11 PQs by utilizing a novel qualitative research method known as narrative analysis. This methodological choice distinguished the study from previous research on qanats, which primarily focused on expert opinions. In contrast, the present study introduced the qanat as a tourist attraction and captured tourists' perspectives on it. Consequently, the study was both unique and timely, as it effectively addressed the gap in the field of tourism management in PQs. In summary, all stakeholders, including researchers, have a significant responsibility to introduce areas prone to tourism, sometimes without any scientific research on tourism. Therefore, due to the global nature of these works, these areas should be identified and introduced in the global arena.

4.11. Qanat tourism model

The final stage of analyzing travel narratives is to extract repetitive dimensions and concepts and develop a research model, as illustrated in Figure 5. The model "The Tourism Potential of Persian Qanat Based on Tourist's Narratives" aims to assess the tourism potential of PQs through the analysis of tourists' narratives. The model consists of seven dimensions that are considered important in evaluating the tourism potential of PQs.

4.11.1. Access path

This criterion focuses on the accessibility and ease of reaching the PQs. It considers factors such as transportation options, signage, availability of maps or guides, and the condition of pathways leading to the qanats. A well-developed and easily accessible access path enhances the tourism potential by attracting more visitors.

4.11.2. Structure and function

This criterion examines the physical structures and functionality of the PQs. It evaluates the preservation and maintenance of the qanat systems, including the tunnels, wells, and water distribution infrastructure. The efficient functioning of the qanats enhances their appeal as tourist attractions.

4.11.3. Historical background

The historical background criterion focuses on the historical significance and narrative of PQs. It considers the historical context, ancient engineering techniques, and cultural heritage associated with the qanats. A strong historical background adds depth and cultural value to the tourism potential of PQs.

4.11.4. Native people

This criterion explores the role and engagement of local communities in preserving and promoting PQs. It considers the involvement of native people in managing the qanats, sharing their knowledge, and offering cultural experiences to visitors. The active participation of local communities contributes to a more authentic and immersive tourist experience.

4.11.5. Local culture

The local culture criterion assesses the cultural elements and traditions related to PQs. It examines the presence of local customs, arts, crafts, music, and culinary traditions that reflect the cultural identity of the communities living around the qanats. The integration of local culture enriches the tourism experience and fosters cultural exchange.

4.11.6. Sense of place

This criterion evaluates the overall ambiance and atmosphere of the PQs. It encompasses the esthetic appeal, tranquility, and unique characteristics that create a sense of place for visitors. Factors such as natural surroundings, architectural elements, and the overall ambiance contribute to a memorable and immersive experience.

4.11.7. Sustainable tourism

The sustainable tourism criterion focuses on the implementation of sustainable practices within the context of PQs. It considers efforts to minimize environmental impact, conserve water resources, promote responsible behavior, and support local economies. The integration of sustainable tourism practices ensures the long-term viability and positive impacts of tourism on the qanats and their surrounding areas.

By assessing each criterion within the model, the tourism potential of PQs can be evaluated based on the narratives and experiences of tourists. This approach allows for a comprehensive understanding of the factors that contribute to the attractiveness and sustainability of PQs as tourism destinations.

5. Conclusion and policy implications

The PQs are a combination of natural and man-made attractions, representing a technical innovation of ancient Iran dating back to 3,000 years ago. These attractions can be considered by tourists as a cultural experience in a destination. This study fills a gap in the field of qanat tourism by applying a new qualitative research method (Narratives analyses) to review 11 qanats in six provinces in Iran. We introduce qanats as a platform for expanding tourism in areas where these aqueducts are located. The present study highlights that introducing qanats can lead to the restart of tourism and strengthen the economy of local people. The results show that qanats as a tourist destination can contribute to the sustainable development of tourism, the preservation of these areas, and the reopening of tourism in the era of postmodern ecotourism.

This research firstly aims to understand the factors that make Persian qanats attractive to foreign tourists. By analyzing tourists' narratives, the study identified the unique characteristics, experiences, and attractions that draw international visitors to Persian qanats. Understanding the factors that contribute to their appeal can help in promoting and marketing Persian qanats as tourist destinations. Secondly, this research explores the narratives and memories of tourists who have visited Persian qanats. By analyzing their narratives, the study aims to uncover the emotional, sensory, and experiential aspects of their visits. This helps to understand the subjective perceptions, interpretations, and storytelling of tourists, providing insights into the aspects of the qanat experience that resonate with visitors and contribute to their overall satisfaction. Thirdly, this

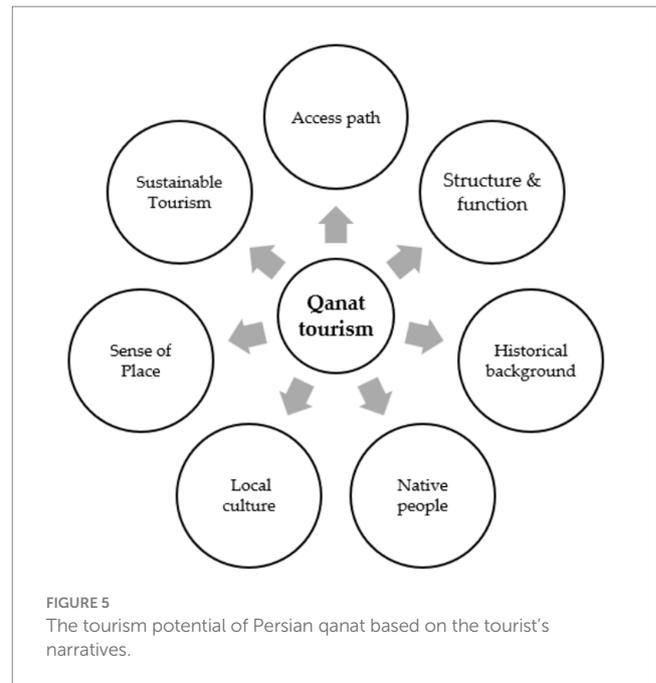


FIGURE 5
The tourism potential of Persian qanat based on the tourist's narratives.

research focused on the perspectives and insights of tour guides regarding PQ tourism and its functions. Tour guides play a crucial role in shaping tourists' experiences and interpretations of the qanats. By exploring the views and opinions of tour guides, the study can gain valuable insights into the educational, cultural, and interpretive aspects of PQ tourism. This knowledge can inform tourism management strategies and enhance the quality of guided tours (Figure 5).

Finally, this research addresses the importance of collecting and publishing travel narratives in tourism management. Travel narratives provide first-hand accounts and personal perspectives of visitors, which can significantly influence the perception and promotion of a destination. By analyzing and sharing these narratives, tourism management can gain insights into tourists' experiences, preferences, and suggestions. This information can inform decision-making processes, destination branding, marketing campaigns, and the development of visitor-centered experiences. Collecting and publishing travel narratives also contribute to destination authenticity and cultural preservation. By documenting and sharing tourists' experiences, local culture, heritage, and traditions associated with Persian qanats can be preserved and promoted, ensuring the sustainability of the destination and fostering a deeper understanding and appreciation among visitors.

We believe that the field of tourism in the qanat civilization will be useful when the importance of the aqueduct is considered along with the increase of tourists' awareness about the significance of qanats. Approaches such as empowering local people and Moghanniss in a structure of job creation, localization of tourism activities, and preventing the drying of qanats will be useful. The usefulness of local people in the crystallization of increasing their welfare is the basis for faster development of tourism in the civilization of PQs. The current research resulted in qanat tourism, as a green industry, focusing on qanat attractions, uniqueness, and history. As a result, tourism can provide a means of preserving this historical and human-made heritage.

The research also confirms that creating solo trips to these areas can protect them from destruction and damage. Therefore, attempts should be made to objectively explain the negative effects of mass tourism on the environment and pristine areas through field studies and scientific research, as well as to strengthen postmodern ecotourism in future studies. In future research, it is suggested that each of the PQs registered in the UNESCO World Heritage be examined separately and professionally from a tourism perspective. The method used in this research for introducing the qanats can be used in other unknown tourist areas affecting ecotourism (Ghorbani et al., 2023a,b,c,d).

In field surveys, it was observed that qanat water is used for fish ponds, agriculture, and horticulture. Future studies could develop and discuss the role of qanats in enhancing the food security of tourists. Examining the architecture and structure of the aqueducts can be an interesting topic for future research. According to the Ministry of Energy, about 41,031 aqueducts have been identified in Iran, and future research can examine the attractions and tourism capabilities of these aqueducts. Strategies for the maintenance and reconstruction of PQs can also be examined in future research.

Since qanat sites are located in rural or developing areas, future research can enrich the fields of tourism and ecotourism to strengthen the economy of local people. Given the debate over qanat agriculture and food security, future studies can focus on these issues. Although recent studies and researchers in this study emphasize the high value and credibility of qualitative studies in tourism research, future research can examine the quantitative components related to qanat tourism based on quantitative studies.

In summary, this study introduces qanats as a tourist destination and highlights their potential in contributing to the sustainable development of tourism, the preservation of these areas, and the reopening of tourism in the era of postmodern ecotourism. It suggests the importance of empowering local people and Moghannis in a structure of job creation, localization of tourism activities, and preventing the drying of qanats. Future research can focus on examining the tourism capabilities of other aqueducts, managing aqueduct water resources, and strengthening the economy of local people.

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Data availability statement

The original contributions presented in the study are included in the article/supplementary material, further inquiries can be directed to the corresponding authors.

Author contributions

HM, AG, and KZ: conceptualization and writing—original draft preparation. AG: methodology. AG and HM: software, data curation, and visualization. FAA, MA, and FP: validation, formal analysis, and investigation. KZ and HM: resources. KZ, HM, and AG: writing—review and editing. KZ and LD: supervision and funding acquisition. HM, KZ, and LD: project administration. All authors contributed to the article and approved the submitted version.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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