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Research Article

Evaluating the river-based tourism potential of the Qezel Ozan river in the Tarom and Qazvin counties, Iran

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Abstract

The Qezel Ozan River and its surrounding areas, in terms of natural, biological, ecological, and social characteristics, have great potential to attract tourists and serve as a promising site for river tourism. This study aims to evaluate the river tourism potential of Qezel Ozan in the Tarom region. In this study, was assessed using a range of environmental parameters, including accessibility, geology, land use, services, slope, flow velocity, water turbidity, and river width. Results of the river tourism suitability zoning show that the initial reaches of the river near Gilvan offer the best conditions for attracting tourists and can be considered a river tourism site. The area surrounding this river due to its natural environmental characteristics, presents an appropriate setting for nature-based tourism, particularly for geotourists. Therefore, in light of the current findings, improving weaker indicators within the study area, alongside further strengthening the critical factors of accessibility and services, could significantly enhance the potential for river-based tourism development in the region. The area surrounding this river due to its natural environmental characteristics, presents an appropriate setting for nature-based tourism, particularly for geotourists. This research examines the tourism potential with an emphasis on geotourism, and attempts are made to identify the potential of this river and introduce it to local communities and tourists.

Keywords: Geotourism, River tourism, Qezel Ozan, Gilvan, Tarom and Qazvin.

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Introduction

Tourism is one of the largest and fastest-growing industries around the world (Sharples, 2002). This industry plays an important role in the economic so that the average growth of tourism incomes has been doubled in the last two decades (Nasarudin and Bahar, 2013). Tourism industry comprises main component of global economy, and it is considered as an industry influencing the cultural, social and environmental issues. Therefore, most countries try to attract tourism capital through improving needed facilities and services for tourists (Elgin and Elveren, 2024; Sofronov, 2017). Human civilizations have been benefited from ecosystem services more than 5000 years (Boon and Raven, 2012; Ellis, 2021; Richter, 2014; Tallis and Kareiva, 2005). Rivers, by providing water and the fertile alluvial plains, have occupied a central place in human history, and sustained the first human settlements, and in so doing helped foster the accumulation of wealth based on agriculture and trade, allowed the great past civilizations to flourish (Kumar and Sajnani, 2020; Prideaux et al, 2009). These wonderful locations have natural attractions and also are appropriate for wide range of human activities such as transport corridors, food resources, providing drinking, industry and agricultural water, energy production, and also in recent years for visiting, spending leisure time and tourism (Prawira et al, 2021; Prideaux et al, 2009). The concepts of ecotourism and geotourism have emerged in tourism literature, experiencing rapid global growth (Chylińska and Kołodziejczyk, 2018; Tesfa and Zewdie, 2023; Xu et al, 2023). The expansion of such tourism in any region necessitates specific conditions and facilities, such as geological phenomena, geomorphic landforms, and natural ecosystems. In recent years, river-based tourism, though observation of landscapes and utilization of fluvial environments as one kind of tourism, has gradually raised its position among international tourists (Prideaux et al, 2009; Silva and Mattos, 2020). Rivers are a major source of tourism, offering scenic attractions, recreational opportunities, riverside landscapes, transportation routes, and an essential source of freshwater for human consumption. In river-based tourism, there exists a direct relationship between river ecosystems and tourism. In general, river tourism is a combination of the river industry and tourism. Rivers, as natural ecosystems, offer numerous aesthetic attractions for tourists by providing unique morphological features, serene and beautiful environments, historical significance, transportation and travel opportunities on the river, facilitation of tourism development through water supply, provision of water for agricultural production, and generation of electricity required for tourism activities, thereby promoting tourism development in various regions (Arif et al, 2022; Hsu et al, 2020; Silva and Mattos, 2020; Xu et al, 2023). Nowadays, river tourism serves as a platform for fostering interactions between nature and humans, and various recreational and sports activities including adventure water activities, water-rafting, river-cruise, kayaking, boating, tubing, swimming, fishing, recreation, river walking, and river travel, are increasingly popular among people and in high demand among tourists worldwide, particularly those seeking challenges, adventures, experiences, and satisfaction (Fachrudin and Lubis, 2016; Lin et al, 2022; Moreira, 2018; Prideaux, 2023). River tourism represents a lucrative trade with the potential of making a major contribution to the local economy through employment in cruise ships, pleasure boats, parks, and recreational facilities along riverbanks (Shakiry, 2007). Implementing tourism projects and activities along rivers can offer potential benefits to local communities and enhance the economic conditions of these areas. Nowadays, water-based tourism is gaining increasing popularity among the public. Local residents must recognize the significance of tourism and work to sustain and enhance activities primarily based on river environments (Fachrudin and Lubis, 2016). Iran boasts diverse geographical conditions, encompassing 11 of the 13 recognized global climates. These conditions have resulted in substantial environmental, nature-based tourism, recreational, and economic capabilities. The tourism industry in Iran possesses considerable potential for growth and expansion. According to the World Tourism Organization, Iran ranks tenth in historical and cultural attractions and fifth in natural attractions globally (UNWTO). In recent decades, the development of tourism in Iran has gained importance in the national economy, aiming to increase foreign exchange earnings and reduce dependence on oil

revenues. Given the country's high potential in attracting tourists, it is imperative to adopt policies that enhance the positive role of tourism in the nation. The Qazvin region is situated on the southern slopes of the Alborz Mountains, and its northern, western, and southern parts have mountainous topography. The climatic diversity and moderate rainfall, particularly in the mountainous areas of the province, have created beautiful and diverse landscapes, offering numerous tourism potentials and attractions, making this region suitable for tourism and related activities. The Qezel Ozan River, one of Iran's longest rivers, originates from the highlands of Kurdistan and East Azerbaijan and, after following a sinuous path, joins the Shahrood River in Manjil to form the Sefidrud River. The banks of this river evoke memories of the ancient Andean civilization, one of the early civilizations of the first millennium BCE. The Qezel Ozan River and its surrounding areas, from environmental, biological, ecological, and social perspectives, can play a significant role in attracting tourists and serve as a potential site for river tourism, including adventure tourism activities such as rafting, kayaking, river cruising, fishing, swimming, etc. River-based tourism can attract numerous tourists and enthusiasts from various parts of the country. Therefore, recognizing and introducing the capabilities of the Qezel Ozan River can lead to increased awareness among local communities, attract tourists, develop and advance the tourism cycle, and ultimately boost the economic cycle and job market in the region. It is possible that implementing tourism projects and activities along rivers has potential benefits for the surrounding local people. Hence, this study examines the river tourism potentials of the Qezel Owzan River in the Tarom area, aiming to identify and introduce the river's capabilities to local communities and tourists.

Materials and Methods

The study area is situated along a 15-kilometer stretch of the Qezel Ozan River and its surrounding region, extending from Gilvan to the vicinity of the Sefidrud Dam Lake, known as Qal'eh Samiran. This area is of interest to tourists from surrounding cities, especially Qazvin, due to its nature-based tourism capabilities with an emphasis on riverside recreation. The pristine nature, beautiful scenery, Sefid Rud Dam Lake, and olive groves have attracted many tourists to the area every year.This area is located at coordinates of 49° 07' 6" to 49°15' 5" longitude and 36°43' 50" to 36° 47' 18" latitude, and it is located in the provinces of Zanjan, Qazvin, and Gilan (Fig. 1). The Qezel Ozan River is one of the longest rivers of Iran. Its source areas is Chehel Cheshmeh highlands in the Divandareh district of Sanandaj County. Then, the river flows through the provinces of Kurdistan, Zanjan, East Azerbaijan, and Ardabil before reaching the Caspian Sea near Hasankiyadeh in Lahijan, Gilan Province. Within the study area, the river nourishes olive orchards and rice Paddy field, eventually entering the Manjil Dam Lake (Sefidrud Reservoir) near the city of Manjil in Gilan Province. The minimum elevation in Qazvin Province (approximately 300 m asl) is found in the Tarom region, adjacent to the Sefidrud Lake. Overall, the elevation within the Tarom region varies between 300 and 2800 meters.

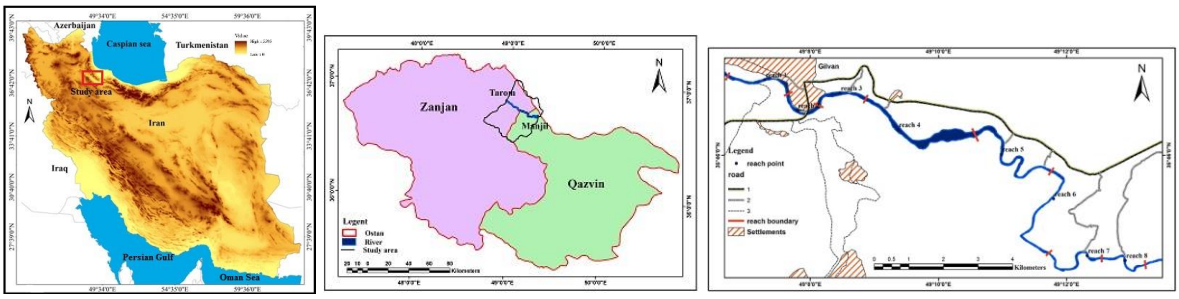

Fig. 1: Map of the study area and watershed location.

The mountainous terrain of the region can be classified into four distinct zones:

-Western Highlands: Including Qajar, Qoozi, Jungle, and Leseleh Daghi Mountains. These form the western boundary of Tarom-e Sofla and Zanjan Province, reaching a maximum elevation of 2485 m asl (Qajar Mountain).

-Southern Highlands: Comprising the Sandan Daghi, Saren Yasar, Biyuk Dash, Dash Bolagh, Soltan Pir, Bahavor, Soltanlu, Goli Bolagh,

Biyanlu, and Kamarsiya Mountains. These mountains demarcate the southern boundary of Tarom-e Sofla and Zanjan Province.

-Eastern Highlands: Including Asbak and Sanjarsar Mountains, with some peaks reaching elevations up to 1300 m asl.

-Central Highlands: including Shamadasht, Sefidkuh, Khaneh Gaduk, Qorkhlar, Goshne Jar, Dagh Daghan, Door, Zakan, Shakhani, and Qarah Dash Mountains. These ranges are separated by numerous deep valleys across the central area of the region.

Geologically, the study area falls within the Western Alborz structural zone. Along the Qezel Ozan River course, various geological formations are exposed including: The Karaj Formation (Eocene), consisting of sandstone, shale, limestone, and minor volcanic tuff and ash; Neogene deposits characterized by red beds with gypsum and conglomerates; Quaternary (Pliocene) units comprising gravel-covered fluvial terraces (Fig. 2).

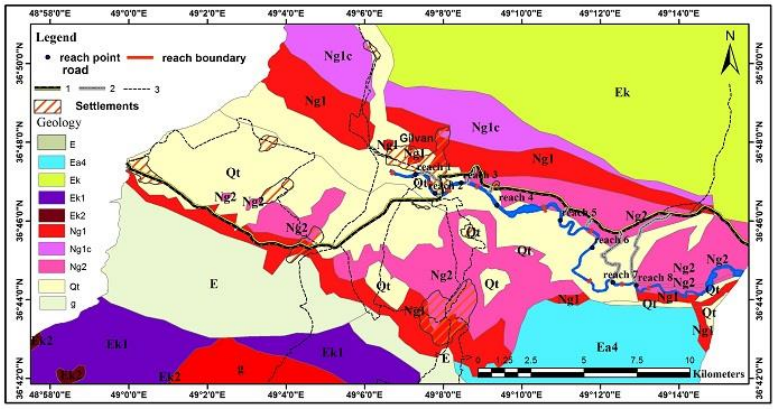

Fig. 2: Map of geological units and formations of the study area.

The land use and vegetation of the region includes agricultural and garden lands (8.3 %), good range (20.8 %), moderate range (34.6 %), poor range (22.7 %) and woodland (13.6 %) lands. The mountainous areas generally exhibit sparse tree cover and are predominantly rangeland. Common vegetation includes juniper (Juniperus spp.), olive (Olea europaea), pomegranate (Punica granatum), fig (Ficus carica), hazelnut (Corylus spp.), and hawthorn (Crataegus spp.) (Fig. 3).

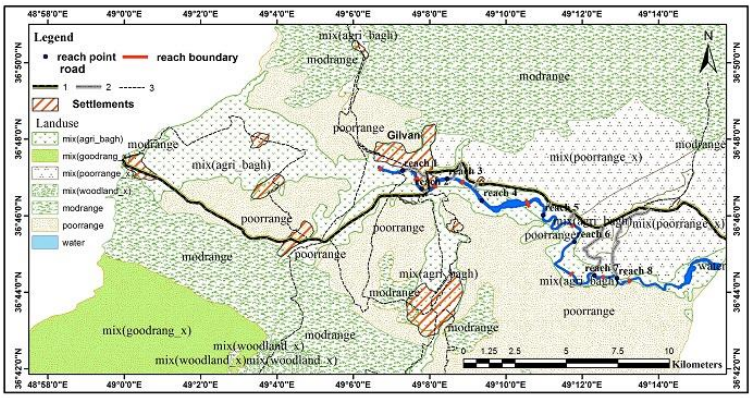

Fig. 3: Land use and vegetation distribution map of the study area

According to the De Martonne climate classification, Tarom County falls under a cold semi-arid climate, while the northern highlands experience a cold semi-humid climate. From an ecological perspective, the region hosts diverse ecosystems, including forest, mountainous, steppe, rangeland, and wetland-riverine habitats. The average annual precipitation of the study area is approximately 250 mm, and the mean monthly temperature is around 19°C. Based on data from the Gilvan hydrometric station, the mean annual discharge of the Qezel Ozan River is estimated at 47.4 m^3/s. In this study, the river tourism potential of the Qezel Ozan River in the Gilvan region was assessed using a range of environmental parameters,

including accessibility, geology, land use, services, slope, flow velocity, water turbidity, and river width.

Accessibility: Accessibility is one of the key factors in evaluating river tourism potential. To create the accessibility layer, the main and secondary roads leading to the selected river reaches were initially digitized using Google Earth environment. Subsequently, roads were classified into three levels (primary, secondary, and tertiary) based on field surveys. Each river reaches was then prioritized according to the proximity and length of access routes.

Geology: The geological map of the study area was prepared using the 1:250,000-scale geological map of Zanjan. For prioritizing each river reach, the number of different lithological formations on both the left and right banks (up to a distance of 500 meters) was identified. Sections with greater geological diversity were assigned higher priorities.

Land Use: Land use data for the region were derived from the national land use map (Ministry of Agriculture Jihad), Google Earth imagery, and field observations. Land use types within 500 meters on both sides of the river were classified in a GIS environment. River reaches were then prioritized based on land use diversity, with the highest diversity receiving the highest priority.

Services: To evaluate service availability, the distance between each river reaches and the nearest service facility (including accommodations, sanitary facilities, supermarkets, etc.) was measured. Sections closer to such amenities were given higher priority.

Slope: Topographic variables such as elevation and slope were derived from the ALOS Digital Elevation Model (DEM) obtained from the Alaska Vertex website and processed using GIS software. River sections with gentler slopes were prioritized higher, as steep slopes may hinder tourism accessibility and safety.

Flow Velocity: River flow velocity was measured during fieldwork for each reach. In terms of tourism suitability, lower flow velocities are more favorable. Therefore, the following classification was applied: priority 1= velocity < 2 m/s (Easy, Novice and Intermediate), priority 2= velocity 2–3 m/s (Difficult or Expert), priority 3= velocity 3–4 m/s (Very Difficult or Expert), priority 4= velocity > 4 m/s (Dangerous).

River Width: The average width of each river reach was calculated based on measured cross-sectional widths. A wider river generally implies lower depth and velocity, enhancing its suitability for recreational activities. Thus, river reaches were ranked as follows: priority 1= width > 100 m, priority 2= width 75–100 m, priority 3= width 50–75 m, priority 4= width < 50 m.

To assign weights to the geological and land use indices, the Simpson Index (Equation 1) was used:

Eq. 1) $$\boldsymbol{D = 1 - \sum(\frac{n\,(n-1)}{N\,(N-1)}}$$

Where n represents the number of samples within a specific group, and N denotes the total number of samples. The value of D varies between 0 and 1. A value close to 0 indicates very high diversity, while a value approaching 1 signifies the dominance of one or a few specific groups and, consequently, low diversity.

For criteria such as accessibility, services, slope, velocity, turbidity, and river width, the Power-Ranking method was used for weighting. In this approach, factors are ranked by expert judgment and final weights are computed based on their ranks using Equation 2:

Eq. 2) $$\text{Weight} = (n - rj + 1)^p$$

In this model, n represents the number of variables, rj denotes the significance and rank of each variable, and p is determined based on expert judgment.

To normalize the values of different variables and achieve a uniform range (0 to 1), Min-Max normalization (Equation 3) was applied:

Eq. 3) $$Z_i = \frac{xi - \min(x)}{\max(xi) - \min(xi)}$$

Where: Zi = normalized value, xi = original value, min(x) and max(x) = minimum and maximum of the variable, respectively.

In order to prioritize the criteria, a survey was conducted based on the opinions of 50 experts and people who worked in the tourism sector (academic colleagues, tourism activists and managers in the region, local stakeholders including restaurant and accommodation owners and tourists), and the final weighting of the layers affecting tourism was carried out using the AHP analytical hierarchy process in the Export Choice software (Table 2). The Analytic Hierarchy Process (AHP) method was employed for final weighting of the effective layers using the Expert Choice software (see

Table 1). The consistency of the AHP method is done by CR. In this study, if the consistency ratio (CR) value is< 0.10, the computation is accepted and it indicates a reasonable accuracy for the pairwise comparison matrix. The consistency ratio (CR) indicates that the CR values for all components are lower than 0.10, which indicates the preferences made in this study are highly consistent.

Table 1: Weights of studied factors obtained in Expert Choice software

parameter	accessibility	geology	land use	services	slope	flow velocity	water turbidity	river width
weight	0.248	0.099	0.103	0.248	0.037	0.075	0.06	0.091

To delineate the recreational suitability of the selected river reaches, the Recreational Potential Index (RPI) was calculated using Equation 4:

Eq. 4) $RPI = \sum_{i=1^{12}} K_i \times W_i, i\ \varepsilon\ [1, 12]$

Where: Ki = normalized value of the i-th criterion, Wi = weight assigned to the i-th criterion. The output values for each interval range from 0 to 8 (index number). Following the generation of the final suitability map, all river reaches were classified into four categories: low, moderate, good, and very good in terms of river tourism potential.

Results and Discussion

This study aimed to assess the tourism potential of the Gilvan region with a particular focus on river tourism. In the initial phase, the potential of the area for river-based tourism was evaluated through expert surveys and questionnaires distributed among stakeholders active in the tourism sector. Subsequently, the environmental conditions and parameters influencing the development of river tourism were analyzed. Eight key parameters (layers) were selected for analysis: accessibility, geology, land use, services, slope, river velocity, river width, and water turbidity. Based on the scoring assigned to each layer, a river tourism suitability zoning map for the Gilvan area was generated.

Criteria for River Tourism Zoning

To delineate river tourism potential zones, eight environmental and anthropogenic layers were utilized. All layers were rasterized at a spatial resolution of 20 meters and integrated using the Analytic Hierarchy Process (AHP) for weighting and overlay analysis. The final output was a suitability map for river tourism along the Qezel Owzan River. The process of data integration and layer interaction is presented in Fig. 4.

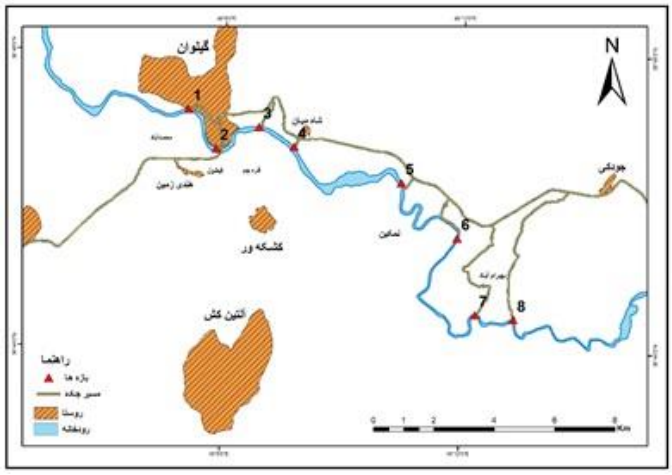

Fig. 4: location of studied reaches of Qezel Ozan River

Accessibility: Accessibility refers to the extent to which tourist sites are reachable without compromising their natural integrity. This parameter plays a critical role in attracting tourists. River reaches that are more accessible to tourists tend to receive more visitors compared to less accessible stretches. According to the generated map, accessibility is highest near Gilvan and declines with increasing distance from the village. The

classification and weighting of reaches based on accessibility are shown in Fig. 5. Reach 2 demonstrates the highest accessibility to road networks, while reaches 1, 3, 5, and 6 exhibit the lowest levels. Reaches 4, 7, and 8 display moderate to low accessibility.

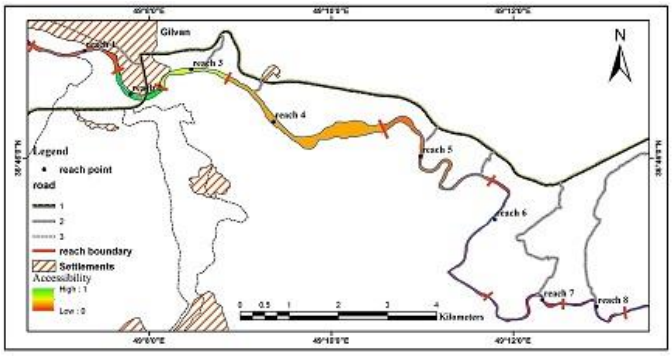

Fig. 5: Map of the reaches access to roads of the study area

Geology: River systems comprise both abiotic components (such as slopes, channels, and networks) and biotic elements (vegetation, riparian habitats, etc.), interacting across nested spatial and temporal scales. At the watershed scale, river systems exhibit low sensitivity to disturbance but long recovery periods; conversely, at the habitat scale, they show high sensitivity but short recovery times (Abijith et al, 2025; Frissell et al, 1986; McCluney et al, 2014). Geological characteristics surrounding the river are key abiotic features influencing erosion rates and geomorphic diversity. Based on the geological map, the area demonstrates moderate lithological diversity, offering limited tourism potential relative to other parameters (Fig. 6).

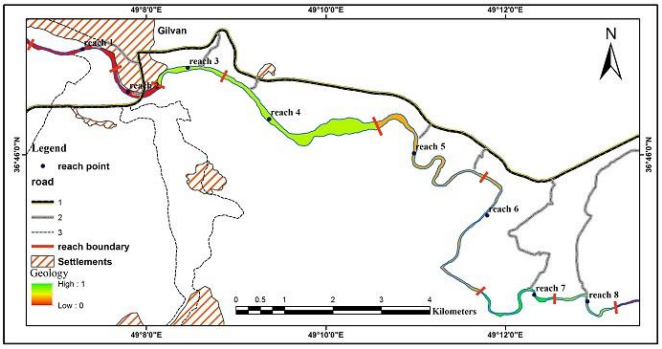

Fig. 6: Map of geological diversity index of the study area

Land Use: Land use patterns significantly affect tourism attraction. The study area includes agricultural land, rangelands, forest patches, and barren lands. The predominant agricultural land use is olive cultivation, which forms the main source of local income (Fig. 7). Results indicate that land use diversity is limited, with reaches 3 to 8 showing greater heterogeneity in land cover types compared to reaches 1 and 2.

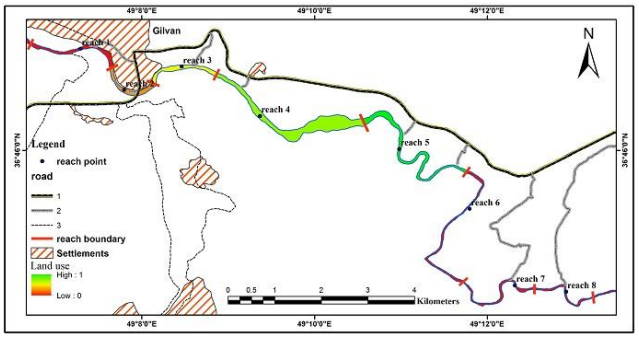

Fig. 7: Map land use diversity index of the study area

Services: Tourism infrastructures, including telecommunications, markets, cafes, and restaurants, are essential for a positive visitor experience. Currently, mobile network coverage is limited and only available in certain zones. Besides natural attractions, political stability and local community involvement are key contributors to tourism growth. Villages connected to main roads benefit from better service provision (Fig. 8). Reach 2 exhibits high service availability due to its proximity to villages, while reach 5 has very limited services. The further the intervals are from settlements, the fewer services are provided.

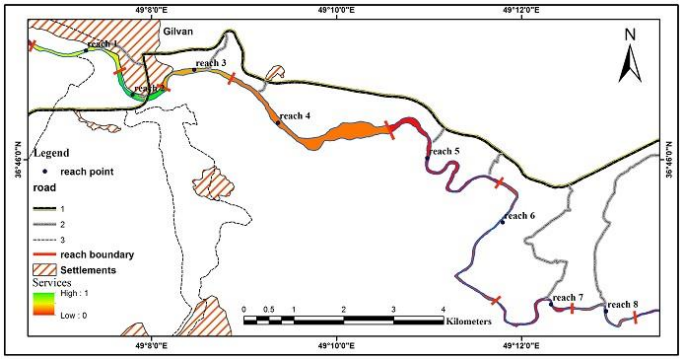

Fig. 8: Map of service distribution of the study area

Slope: The longitudinal profile of the main river provides insights into infiltration, flow velocity, discharge, and erosive power. Slope is a major determinant of hydrological response and topographic variability within a watershed (Gebrie Habte et al, 2024; Pradhan, 2010). For general river tourism, gentle slopes are preferred as they result in slower flows. However, for adventure-based tourism such as rafting, steeper slopes and higher velocities are favorable (Fig. 9). Reaches 2 and 3 feature steeper slopes, while reaches 4, 5, and 6 exhibit lower gradients with meandering patterns.

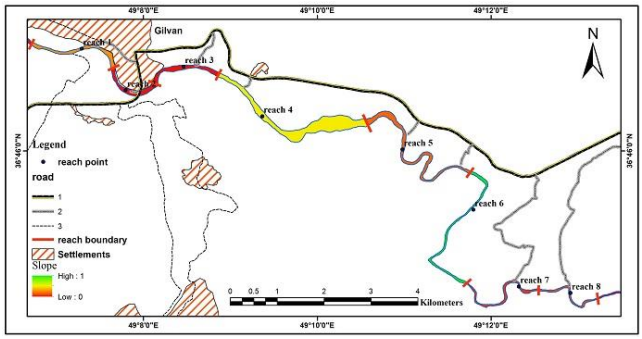

Fig. 9: Map of slope index of the study area

Velocity: River velocity was categorized into four international classes: Easy, Novice and Intermediate (priority 1), Difficult or Expert (priority 2), Very Difficult or Expert (priority 3), Dangerous (priority 4) based on standards for boating and water-based recreation. Field measurements and mapping revealed that flow velocity in the studied reaches ranged from low to moderate. Prioritization and weighting of river reaches were based on these measurements (Fig. 10). Reaches 5 to 8 show moderate to high velocities, while reaches 1 and 2 display very low flow, making the river suitable for different tourism activities depending on flow intensity (e.g., boating, swimming, rafting).

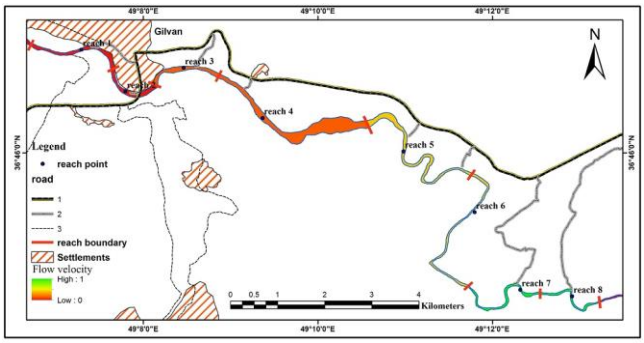

Fig. 10: Map of diversity of flow velocity of study area river

Width: River width, depth, and flow velocity are interrelated. With constant discharge, an increase in river width typically results in decreased depth and velocity, or vice versa. Therefore, wider river sections with lower depths and flow rates are more suitable for non-adventure, general river tourism (Fig. 11). Reaches 1 to 4 were identified as having greater widths and lower depth and flow velocity, making them more favorable for public river recreation.

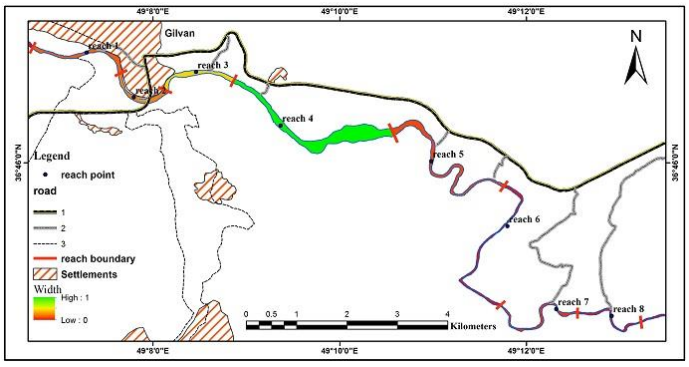

Fig. 11: Map of distribution of width of study area river

Turbidity: Water turbidity significantly affects the quality of river tourism. High turbidity reduces water clarity, diminishes aesthetic value, and negatively impacts activities such as swimming and photography. Furthermore, high turbidity, often caused by suspended solids, poses health risks and reduces biodiversity, thereby threatening ecotourism dependent on healthy ecosystems (Fig. 12). Reaches 2 and 5 recorded high turbidity levels; reaches 7 and 8 had moderate turbidity, while the remaining reaches had low turbidity levels.

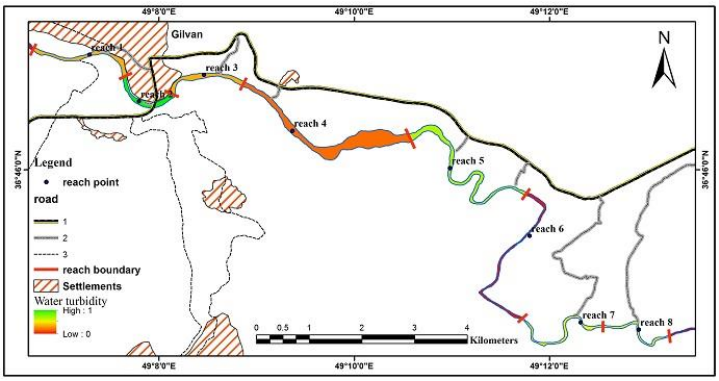

Fig. 12: Map of Water turbidity of study area river

River Tourism Suitability Zoning

The river tourism suitability zoning for the Qezel Ozan River in the Gilvan region was conducted using eight environmental parameters (Fig. 13). Final weights were assigned based on both the calculated influence of each parameter and expert judgment (Table 2). Accessibility and service provision received

the highest weights (Table 16). According to the final suitability map, one reach was classified as "very suitable" and two reaches as "suitable" for river tourism development (Table 3). All reaches were subsequently classified into four suitability classes: low, moderate, high, and very high (Table 4).

Table 2: Normalized weights of studied parameters in each reach

reach	accessibility	geology	land use	services	slope	flow velocity	water turbidity	river width
1	0.09	0.01	0.01	0.42	0.23	0.01	0.14	0.33
2	1	0.01	0.25	1	0.01	0.01	0.23	1
3	0.43	0.67	0.5	0.23	0.01	0.11	0.42	0.33
4	0.24	0.67	0.75	0.14	0.43	0.11	1	0.17
5	0.14	0.33	1	0.01	0.14	0.33	0.09	0.67
6	0.05	0.33	0.01	0.05	1	0.33	0.01	0.01
7	0.02	1	0.01	0.01	0.05	1	0.05	0.5
8	0.01	0.67	0.01	0.09	0.09	1	0.01	0.5

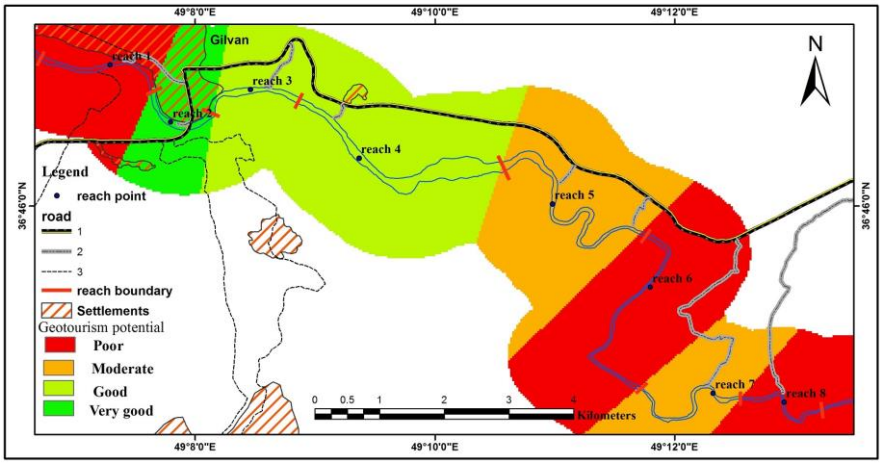

Fig. 13: Map of tourism suitability zoning of the study area

Table 3: Tourism potential and Length of reaches

reach	Reach (m)	geotourism potential
1	1864.5	Poor
2	1454.4	Very good
3	1164.2	Good
4	3241.6	Good
5	3693.7	Moderate
6	3238.2	Poor
7	2122.3	Moderate
8	1797.9	Poor

Table 4: Area and frequency percent for zones of geotourism potential of the study area

rank	geotourism potential	Frequency (%)
1	Poor	37.15
2	Moderate	31.31
3	Good	23.72
4	Very good	7.83

Discussion

To evaluate the river tourism potential of the Qezel Ozan River in the Gilvan region and its continuation within the Manjil district, a study was conducted based on the analysis of key indicators influencing tourism development. The study assessed the region's capacity for geotourism using eight environmental variables specifically related to river systems and adjacent environments. The river-related parameters included flow velocity, river width, water turbidity, and river depth, all of which can significantly impact tourism activities. Additional factors associated with access and peripheral features included road networks, geology, land use, and general accessibility, all of which determine the ease with which tourists can reach the river environment. The main

feature of river tourism is water, which is one of the most popular natural places for relaxation and recreation. It is claimed that even short periods near water have a beneficial calming effect on most people (Frazier, 2000).The assessment of the Qezel Ozan River's tourism potential revealed that, despite the natural and pristine conditions of the region, river reaches don't have equal potential for tourism development. Among the evaluated criteria, accessibility and service availability emerged as the most influential factors in attracting visitors to the studied reaches. Reach 2, located near the town of Gilvan and featuring access to services such as accommodations, dining facilities, and mobile network coverage, demonstrated the highest tourism potential. The study by Kumar and Sajnani (2020) also suggested that the solution to revive river tourism and its lost connection with the city is to make them accessible to the public, preserve the vital line of the Yamuna River in Delhi, and promote river-centric tourism in Delhi. Field observations and interviews with local residents confirmed the findings of the analytical model. During weekends and holidays, large numbers of people, particularly from Qazvin, visit the area for leisure, fishing, and swimming, leading to overcrowding in reaches near the city—especially reaches 2, 3, and 4. On the other hand, reaches without direct access are more suitable for fishing enthusiasts and geotourists, who tend to be fewer in number and prefer reaches 5 to 8. These latter reaches, due to their deeper waters and denser riparian vegetation (primarily dominated by tamarisk species), offer ideal conditions for fishing. Given the natural environmental conditions and the absence of infrastructural development, this region serves as a favorable destination for nature-based tourism, particularly for geotourism and ecotourism enthusiasts. A study by Budisetyorini et al. (2021) showed that considering the natural attractions of the Asahan River and prioritizing environmental, socio-economic and cultural benefits provides a mixed approach to sustainable tourism development strategies. According to Prideaux and Cooper (2009) and Prideaux (2023), rivers are an important tourism resource that provides scenic spots, recreational opportunities, and coastal landscapes of interest to tourists. The results of the study by Hafizudin et al. (2013) and Moreira (2018) showed that river tourism will provide leisure activities and a basis for local and regional development. The presence of beautiful and pristine natural landscapes in the Gilvan region means that this region has great potential for the development of river tourism. In order to sustainably develop tourism in the Gilvan and Tarom regions, it is necessary to increase public awareness, and governments and management institutions in the region need to implement policies to promote ecotourism in the region (Arif et al, 2022). The results of the study showed that despite the high potential for the development of river tourism in the Gilvan region, the peripheral location of the region and the lack of necessary infrastructure have caused tourism to still occupy a small part of the regional economy. The findings of Prideaux and Lohmann (2009) in their study of Amazon river tourism have also yielded similar results.

Conclusion

The study of the tourism potential of the Qezel Ozan River in the Gilvan and Manjil regions, based on the study of effective indicators in tourism, showed that the average sector accounted for 31.31 percent, the good sector for 23.72 percent, and the very good sector for 83.7 percent. Overall, 2 and 4 reaches scored the highest points and and were classified within the "very good" and "good" categories. In contrast, reaches 1, 6, and 8 were categorized as having poor tourism potential. Overall, the zoning results indicate that reaches close to the city of Gilvan offer more favorable conditions for attracting tourists and can be considered suitable as designated tourism sites. The Gilvan region has a huge potential for river tourism development, however, due to various reasons including the peripheral location of the region and the lack of necessary infrastructure, tourism still accounts for a small part of the region's economy. It is likely that future development patterns including land-based tourism in the vicinity of the river, including eco-parks, eco-lodges, nature-based tourism, and more specific river tourism, including fishing and boating, could provide a basis for tourism prosperity in the region. Based on the findings of this study, in order to manage tourism in the region, it is necessary for the public sector to provide at least the first stage of development by providing the necessary infrastructure such as communication routes. After the necessary infrastructure is established,

the private sector will have a significant opportunity to play its role in tourism development in the Gilvan region. In order to sustainably develop tourism in the Gilvan and Tarom regions, a cautious approach to development, including determining a certain level of the number of visitors in environmentally sensitive areas, is needed to prevent future problems in the region. Therefore, in light of the current findings, improving weaker indicators within the study area, alongside further strengthening the critical factors of accessibility and services, could significantly enhance the potential for river-based tourism development in the region. The area surrounding the Qezel Ozan River—stretching from the city of Gilvan to the Manjil Dam—due to its natural environmental characteristics and lack of infrastructural development, presents an appropriate setting for nature-based tourism, particularly for geotourists and ecotourism enthusiasts.

Declaration of interest statement

The authors report that there are no competing interests to declare.

Authorship contribution

The Author Contributions at this stage are as follows.

Conceptualization: [Mohamad Mahdi Hosseinzadeh], [Sharam Bahrami], [Mobina Ghanbari]; Methodology: [Mohamad Mahdi Hosseinzadeh], [Mobina Ghanbari]; Formal analysis and investigation: [Mohamad Mahdi Hosseinzadeh], [Mobina Ghanbari]; Writing - original draft preparation: [Mohamad Mahdi Hosseinzadeh], [Sharam Bahrami]; Writing - review and editing: [Mohamad Mahdi Hosseinzadeh], [Sharam Bahrami],; Funding acquisition: [Mohamad Mahdi Hosseinzadeh], [Sharam Bahrami], [Mobina Ghanbari]; Resources: [Mohamad Mahdi Hosseinzadeh], [Mobina Ghanbari]; Supervision: [Mohamad Mahdi Hosseinzadeh], [Sharam Bahrami] . All authors have read and agreed to the published version of the manuscript. This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

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