



Original Research Article

Locating Potential Areas for Tourism Development with an Emphasis on Transportation Development: A Case Study of Tonekabon City

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| ARTICLE INFO   | Abstract   |
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| <p><b>Article History:</b><br/>Received: 2025/04/24<br/>Revised: 2025/05/16<br/>Accepted: 2025/05/27</p> <p><b>Keywords:</b><br/>Location analysis<br/>tourism development<br/>public transportation<br/>Tonekabon city<br/>IHWP model</p> <p>DOI: <a href="https://doi.org/10.82173/jlUSD.2025.1213196">10.82173/jlUSD.2025.1213196</a></p> | <p><b>Background and Objectives:</b> Efficient public transportation systems are fundamental to enhancing tourist satisfaction and achieving sustainable urban development. This study aims to identify and prioritize suitable areas for tourism development by implementing the Transit-Oriented Development (TOD) approach to address these transportation limitations.</p> <p><b>Methods:</b> This applied research utilized a descriptive-analytical methodology. Data were collected through documentary studies, field observations, and a survey questionnaire distributed to a panel of 48 experts. The Fuzzy Inverse Hierarchical Weighted Prioritization (IHWP) model was employed within a Geographic Information System (GIS) environment to analyze and integrate eight key spatial indicators, including land-use mix, population density, and accessibility to transportation networks.</p> <p><b>Findings:</b> The analysis revealed that approximately 29% of the city's area, predominantly in the northern (coastal), central, and western zones, possesses high potential for TOD-focused tourism infrastructure. Conversely, 34% of the area, mainly on the eastern and southern peripheries, was identified as having low potential.</p> <p><b>CONCLUSION:</b> The study successfully demonstrates the application of the Fuzzy IHWP model for spatial planning in tourism development. The findings provide an empirical basis for targeted interventions, such as concentrating commercial and recreational activities in the coastal strip, establishing dedicated bicycle lanes, and improving public parking facilities.</p> |

**Running Title:** Locating Potential Areas for Tourism Development with an Emphasis on Transportation Development

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## Introduction

Transportation is widely recognized as a fundamental pillar of the global tourism industry, significantly influencing tourist satisfaction, destination accessibility, and sustainable development (Shad *et al.*, 2016; Van Trong; Rezaei, 2025 & Shimizu, 2017). In the dawn of the third millennium, tourism stands as one of the most important and lucrative global resources, with its growth directly correlated to the advancement of transportation systems. The primary assumption of public transportation development based on sustainable tourism is increasing tourist satisfaction, as travelers heavily factor in both cost and time when making decisions (Khan *et al.*, 2016). The choice of transportation system, or the availability of an appropriate one, critically affects these two factors in accessing tourist destinations.

One of the most advanced urban development perspectives that can initiate improvements in current urban conditions and serve as an effective step toward sustainable development is Transit-Oriented Development (TOD) (Shahabian, 2011; Sarlak & Parizadi, 2018). TOD models guide urban growth around public transportation axes, promoting dense, mixed-use development that provides a sustainable mobility solution. This approach emphasizes the mutual relationship between public transportation and urban form, creating pedestrian-friendly environments within walking distance of transit hubs (Calthorpe, 1993; Abbaszadegan *et al.*, 2012).

The theoretical framework of this study rests on two interconnected pillars: the principles of sustainable tourism and the model of TOD. The integration of these concepts is essential for understanding how transportation planning can directly catalyze tourism growth in an urban context.

### Sustainable Tourism and Transportation Nexus

Tourism has evolved from a niche activity to a major global industry and a key leisure pursuit, significantly impacting economies, environments, and social structures (Jelincic, 2016; UNWTO, 2022). However, its resource-intensive nature necessitates a shift towards

sustainability. Sustainable tourism is defined as tourism that manages all resources to fulfill economic, social, and aesthetic needs while maintaining cultural integrity, ecological processes, and biodiversity (World Tourism Organization, 2023). A critical, yet often underestimated, component of this sustainability is the transportation system. Transportation is not merely a means of access but is intrinsically linked to the tourist experience, influencing destination choice, satisfaction, and environmental footprint (Peeters *et al.*, 2019; Shad *et al.*, 2016). Efficient, affordable, and comfortable transportation facilities are prerequisites for tourism development, as they directly impact the two primary decision-making factors for tourists: cost and time (Khan *et al.*, 2016).

This is particularly crucial in coastal cities like Tonekabon, where the concentration of activities in a narrow strip between land and sea intensifies human pressure and necessitates careful planning to prevent environmental degradation (Ramadanzadeh Lasboei *et al.*, 2014; Hall, 2020). Sustainable coastal tourism, therefore, depends on a transportation strategy that minimizes congestion and pollution while maximizing accessibility.

TOD has emerged as a leading urban development paradigm that aligns urban form with high-capacity transit systems to create more livable, walkable, and sustainable communities (Calthorpe, 1993; Ibraeva *et al.*, 2020). It moves beyond the mere provision of public transit to integrate land use and transportation planning actively. The core principle of TOD is developing compact, mixed-use neighborhoods within a walking distance (typically 500-800 meters) of high-quality public transport stations, thereby reducing dependency on private vehicles (Singh *et al.*, 2017).

The relevance of TOD for tourism is multifold:

**Enhanced Accessibility:** TOD creates nodes of high accessibility, making it easier for tourists to navigate a city and reach multiple attractions without a car (Javadi-Pour & Daryani, 2016).

Improved Visitor Experience: Walkable, pedestrian-friendly environments around transit hubs are often more attractive and enjoyable for tourists, fostering exploration and longer stays (Litman, 2022).

Sustainability: By reducing vehicular traffic, TOD directly contributes to environmental sustainability—a key concern for modern tourists—by lowering emissions and congestion in sensitive tourist zones (Ewing & Hamidi, 2015).

Empirical studies consistently affirm the strong link between transportation and tourism. Research by Van Trong & Shimizu (2017) and Albalade & Fageda (2019) demonstrates that investments in public and rail transport significantly boost tourist arrivals. Khan *et al.* (2016) found that air and rail connectivity are positive predictors of tourism competitiveness. At a local level, studies in the Iranian context (e.g., Javadi-Pour & Daryani, 2016; Eslam Shoaar & Jamali Basir, 2014) have argued for the TOD approach as essential for urban tourism development.

However, a gap exists in the application of advanced spatial modeling to precisely locate and prioritize areas for TOD implementation specifically aimed at enhancing tourism. Many studies discuss the theory or general benefits but lack a granular, indicator-driven methodology for planning. This research seeks to fill this gap by applying the Fuzzy IHWP model to the case of Tonekabon, moving from theoretical advocacy to actionable, spatially-explicit planning. It builds upon the existing literature by quantitatively synthesizing key TOD indicators—such as land-use mix, density, network accessibility, and pedestrian infrastructure (Cervero & Kockelman, 1997; Ewing & Cervero, 2010)—to directly serve tourism development objectives.

The study area is the coastal city of Tonekabon, located in the western part of Mazandaran Province along the Rasht-Chalus route. According to the latest population census in 2016, its population amounts to 55,434 people. The city lies between two main arteries: one in the southernmost part of the city (the Tonekabon bypass) and the other in the northern part, which is the Rasulian axis, continuing as Imam Khomeini Street.

Tonekabon is an urban area with a fully occupied fabric, though some parts of its coastline remain usable for tourism. Given the existing tourism infrastructure, only through principled management—such as the development of public transportation—can it become one of the country's major tourist-receiving cities. Additionally, Tonekabon, apart from its coastal potential, benefits from a very narrow plain that lies extremely close to the sea, allowing tourists to reach the shore in a short time. This advantage, under the application of a public transportation development approach, can effectively enhance tourism.

Tonekabon, with its natural potentials (such as the sea, beaches, waterfalls, forests, mountains, and a favorable climate), as well as its historical and cultural assets, is today considered one of the most important domestic tourist destinations in Iran. Its location along the coastal tourism route of the Caspian Sea and its proximity to Tehran are among the most significant spatial-geographical factors that have placed this city at the center of attention for travelers seeking tourism activities.

In recent years, however, Tonekabon has faced detrimental developments, including uncontrolled construction in elevated areas, deforestation for villa construction, encroachment on forested areas by various fish farming projects, and the establishment of poorly equipped and improperly designed temporary tourist facilities. Most critically, after the construction of an incomplete, inadequate, and poorly planned urban bypass, Tonekabon's status as a tourist destination has sharply declined.

The city of Tonekabon, with its significant natural potentials including coastline, forests, and favorable climate as well as historical and cultural assets, is a major domestic tourist destination in Iran. Its location along the Caspian Sea and proximity to Tehran have placed it at the center of attention for travelers (Ramadanzadeh Lasboei *et al.*, 2014; Seydi *et al.*, 2018). However, in recent years, the city has faced detrimental developments such as uncontrolled construction, deforestation, and the establishment of poorly planned tourist

facilities. Most critically, the construction of an incomplete and inadequate urban bypass, coupled with a weak public transportation system, has severely hampered its tourism potential and led to a decline in its status as a preferred destination. The lack of suitable, reliable, comfortable, and affordable transportation facilities poses a significant barrier to sustainable tourism development, creating congestion, reducing accessibility, and diminishing the overall tourist experience.

Therefore, the necessity of this research stems from the urgent need for integrated planning that synergizes transportation infrastructure with tourism development in Tonekabon. By applying a TOD approach, this

study seeks to address these challenges and leverage the city's inherent potential. Consequently, this study is guided by the following research questions and hypotheses:

Research Questions:

- 1- Which areas in Tonekabon city have the highest potential for tourism development with an emphasis on transit-oriented development (TOD)?
- 2- What are the most critical indicators for locating public transportation stations to enhance tourism?
- 3- What practical strategies can be proposed to improve the public transportation system for tourism development in Tonekabon?

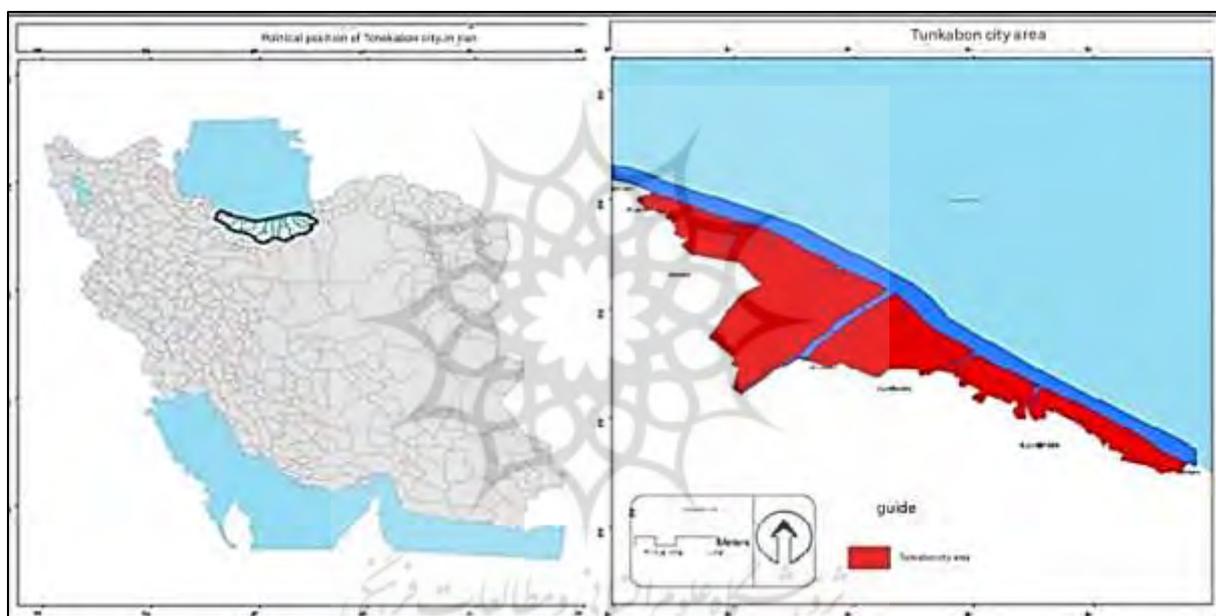


Fig. 1: Location of Tonekabon city

The aim of the current study is to identify and locate areas suitable for tourism development with an emphasis on the TOD approach. This study has been carried out in Tonekabon city, Iran in which the data collection and analysis were conducted leading up to its publication in 2024.

### Materials and Methods

This applied research employs a descriptive-analytical methodology. Data was collected through documentary studies, field observation, and a survey questionnaire.

Data Measurement and Analysis Tools:

Data Collection Tools: A questionnaire was designed based on identified indicators and distributed to a panel of experts (n=48, selected via targeted sampling using Cochran's formula).

Data Analysis Tool: The Fuzzy Inverse Hierarchical Weighted Prioritization (IHWP) model was applied within a Geographic Information System (GIS) environment to analyze the data and generate the suitability map.

Analytical Process: The analysis involved weighting and standardizing eight key spatial indicators (including land-use mix, population density, access to transportation networks,

and proximity to taxi stations) using the IHWP model. These weighted layers were then integrated in GIS to produce a final map zoning the study area by its potential for tourism-focused TOD.

**Results and Discussion**

This study utilized the Fuzzy IHWP model to analyze eight spatial indicators and identify areas in Tonekabon with high potential for tourism development through a TOD approach. The results of the weighting and analysis are presented below.

*Indicator Weighting and Prioritization*

The first crucial step involved determining the relative importance of each indicator. This was achieved using the Delphi method, where

expert opinions were solicited to rank the indicators. The results, presented in [Table 1](#), show that "Access to Taxi Stations" was ranked as the most critical factor (Inverse Rank: 8), underscoring the immediate need for accessible and reliable last-mile connectivity for tourists. This was closely followed by "Density and Land Use Mix" (Inverse Rank: 7), which is a core tenet of TOD, promoting walkability and reducing the need for private vehicle use. Conversely, "Building Density" was assigned the lowest weight (Inverse Rank: 1), suggesting that while important, it is a secondary factor compared to functional and accessibility metrics in this specific tourism-oriented context.

**Table 1:** Degree of importance of indicators resulting from the Delphi questionnaire

| Weighting Assumptions  | Inverse Rank | Rank | Indicator                                     |
|--|--------------|------|---|
| Increased accessibility reduces personal car usage, and neighborhood units in central areas use cars 10–30% less.  | 8            | 1    | Access to taxi stations                       |
| Mixed land use reduces personal car travel distance and increases the use of alternative modes such as cycling.  | 7            | 2    | Density and land use mix                      |
| Increased accessibility reduces personal car usage, and neighborhood units in central areas use cars 10–30% less.  | 6            | 3    | Access to the transportation network          |
| Increased density leads to a reduction in per capita car travel. Every 10% increase in urban density reduces vehicle miles traveled by 2–3%.                               | 5            | 4    | Population density                            |
| Due to distancing from traffic problems, personal car commuting decreases, and the tendency to use public transportation increases.  | 4            | 5    | Distance from low-service-level intersections |
| Due to distancing from traffic problems, personal car commuting decreases, and the tendency to use public transportation increases.  | 3            | 6    | Distance from low-service-level routes        |
| Increased accessibility reduces personal car usage, and the fewer public parking spaces available, the greater the inclination to use non-motorized transport and walking. | 2            | 7    | Access to parking lots                        |
| Increased density leads to a reduction in per capita car travel. Every 10% increase in urban density reduces vehicle miles traveled by 2–3%.                               | 1            | 8    | Building density                              |

*Suitability Analysis and Zoning*

Each of the eight indicators was mapped, classified, and weighted according to the values derived from the IHWP model (as exemplified in [Table 2](#) for classification and

scoring). The subsequent overlay of these weighted layers in the GIS environment produced the final tourism development potential map ([Fig. 2](#)).

**Table 2:** Weighting Indicators for Suitable Tourism Zones with Emphasis on Public Transportation

| Indicator              | Classification | x    | i | Description |
|------------------------|----------------|------|---|-------------|
| Land Use Density & Mix | < 2.0          | 1.04 | 1 | Very Low    |
|                        | 2.0–4.0        | 2.08 | 2 | Low         |
|                        | 4.0–6.0        | 4.02 | 3 | Moderate    |

| Indicator                               | Classification              | x                | i    | Description |
|---|-----------------------------|------------------|------|-------------|
|   | 6.0–8.0                     | 5.06             | 4    | High        |
|   | 8.0–10.0                    | 7.00             | 5    | Very High   |
| Access to Taxi Stations                 | < 200 m                     | 1.06             | 1    | Excellent   |
|   | 200–500 m                   | 1.06             | 4    | Good        |
|   | 500–1000 m                  | 1.06             | 3    | Average     |
|   | 1000–1500 m                 | 1.06             | 2    | Poor        |
|   | > 1500 m                    | 1.06             | 5    | Very Poor   |
|   | Transport Network Hierarchy | Grade 1 Arterial | 2.00 | 3           |
| Grade 2 Arterial                        |                             | 2.00             | 2    | Secondary   |
| Collector/Distributor                   |                             | 2.00             | 1    | Local       |
| Population Density                      | < 100 p/ha                  | 1.52             | 1    | Very Low    |
|   | 100–120 p/ha                | 2.05             | 2    | Low         |
|   | 120–140 p/ha                | 3.57             | 3    | Moderate    |
|   | > 140 p/ha                  | 5.00             | 4    | High        |
| Access to Parking                       | < 200 m                     | 0.08             | 5    | Excellent   |
|   | 200–400 m                   | 0.08             | 4    | Good        |
|   | 400–600 m                   | 0.08             | 3    | Average     |
|   | 600–1000 m                  | 0.08             | 2    | Poor        |
|   | > 1000 m                    | 0.08             | 1    | Very Poor   |
| Distance from Low-Service Roads         | < 100 m                     | 0.06             | 1    | Very Poor   |
|   | 100–150 m                   | 0.06             | 2    | Poor        |
|   | 150–300 m                   | 0.06             | 3    | Moderate    |
|   | 300–500 m                   | 0.06             | 4    | Good        |
|   | > 500 m                     | 0.06             | 5    | Excellent   |
| Distance from Low-Service Intersections | < 100 m                     | 0.33             | 1    | Very Poor   |

| Indicator        | Classification | x    | i | Description |
|------------------|----------------|------|---|-------------|
|                  | 100–200 m      | 0.33 | 2 | Poor        |
|                  | 200–300 m      | 0.33 | 3 | Moderate    |
|                  | 300–400 m      | 0.33 | 4 | Good        |
|                  | 400–500 m      | 0.33 | 5 | Very Good   |
|                  | > 500 m        | 0.33 | 6 | Excellent   |
| Building Density | < 5%           | 0.33 | 1 | Very Low    |
|                  | 5–6%           | 0.33 | 2 | Low         |
|                  | > 6%           | 0.33 | 3 | Moderate    |

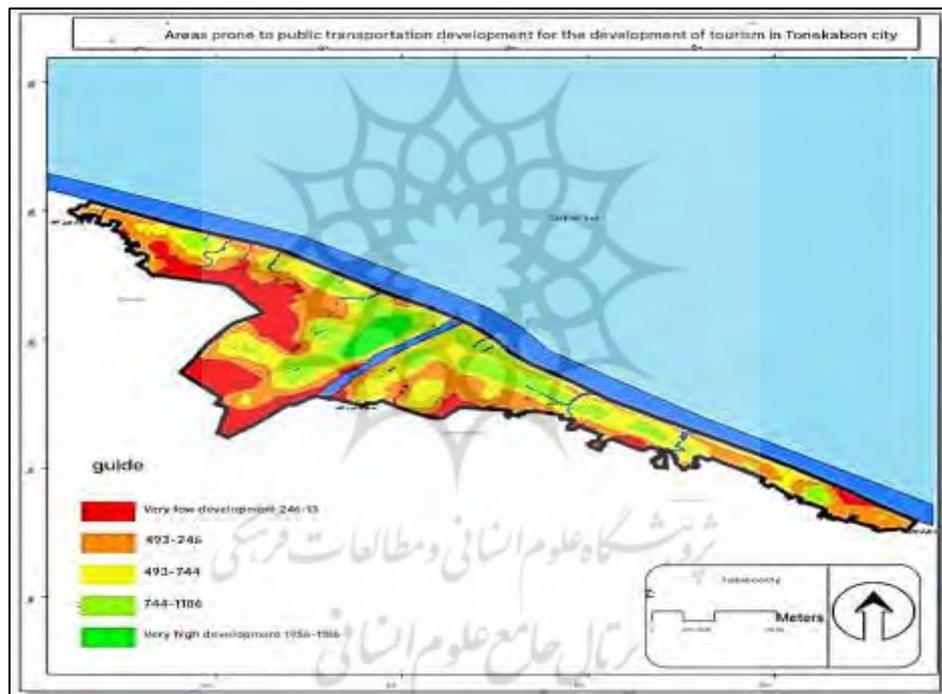


Fig. 2: Location of tourism-prone areas using the IHWP model

*The analysis reveals a clear spatial pattern:*

High and Very High Potential Zones (29% of the city): These areas are predominantly concentrated in the northern (coastal strip), central, and parts of the western regions of the city. This distribution aligns perfectly with the theoretical framework of TOD, as these zones naturally exhibit a higher mix of commercial, recreational, and hospitality land uses, higher population density, and better existing access to the main transportation network (Imam

Khomeini St., Rasulian Axis). These findings confirm the first hypothesis of this study.

Low and Very Low Potential Zones (34% of the city): These areas are primarily located on the peripheral eastern and southern fringes. They are characterized by lower density, predominantly residential use, poorer connectivity to the main transport arteries, and greater distances from key tourist attractions, which limits their immediate suitability for TOD-led tourism investment .

The findings are consistent with previous research that highlights the critical link between transit accessibility, land-use mix, and tourism viability (Javadi-Pour & Daryani, 2016; Eslam Shoaar & Jamali Basir, 2014). The identification of the coastal and central areas as prime locations mirrors studies emphasizing the importance of concentrating tourist services in accessible, high-activity corridors to enhance the visitor experience and manage environmental pressure (Hayllar *et al.*, 2008; Ramadanzadeh Lasboei *et al.*, 2014).

However, this study moves beyond general correlation by providing a quantitative, spatially-explicit prioritization model. While Khan *et al.* (2016) established a national-level link between transport and tourism competitiveness, this research offers a localized framework for actionable planning, a gap identified in the theoretical foundation. The use of the Fuzzy IHWP model addresses the complexity and subjectivity of urban planning criteria, a challenge noted in similar land-use suitability studies (Abazarlou, 2013).

The key implication is that public transportation development must be strategically focused on the high-potential zones to be most effective. For instance, establishing new taxi stands, van routes, and bicycle lanes in the central and coastal corridors would yield a higher return on investment by serving the greatest number of tourists and residents simultaneously, thereby directly addressing the city's current transportation challenges and fulfilling the core objective of TOD.

### Conclusion

This study successfully identified and prioritized zones for tourism development in Tonekabon using a TOD approach and the Fuzzy IHWP model. The core findings confirm that:

**Spatial Distribution:** Approximately 29% of the city's area, specifically the central, northern, and coastal zones, possesses high potential for TOD-focused tourism infrastructure.

**Key Indicators:** Accessibility (to taxis and transport networks) and functional density (land-use mix) are the most critical

determinants for success, outweighing purely physical metrics like building density.

**Strategic Planning:** The results provide an empirical foundation for targeted investment. Recommendations include concentrating commercial and recreational activities in the coastal strip, creating a ring road to bypass congested centers, defining new bus routes, building public parking near terminals, and establishing dedicated bicycle lanes along the coastline.

These findings align with and extend the global discourse on sustainable tourism by demonstrating how advanced spatial modeling can translate TOD principles into a concrete planning tool for coastal cities. The methodology offers a replicable framework for other similar tourist destinations facing challenges of congestion and unsustainable access.

### Author Contributions

F. Rafipour, the corresponding author, has contributed in supervising the second author in the data analysis, interpreted the results, and preparing the manuscript.

### Conflict of Interest

The author declares that there is no conflict of interests regarding the publication of this manuscript. In addition, the ethical issues, including plagiarism, informed consent, misconduct, data fabrication and/or falsification, double publication and/or submission, and redundancy have been completely observed by the authors.

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#### **Negative Ai Statement**

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