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Mapping of sustainability of Tourism products potentials by Applying GIS-Decision Making Systems in Tabriz city, Iran

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ABSTRACT

The importance of sustainability development for developing countries and their tourism is a major issue. This study presents a new approach and framework for spatial modelling of tourism products potentials (TPP) in their sustainability evaluation. The approach was developed based on the GIS multi-criteria decision analysis (MCDA) and its performance was evaluated for spatial TPP mapping in Tabriz city, Iran. To achieve this purpose, we recognized the main Components of Tourism Development indicators (CTDI) such as attractions, accommodation, services and infrastructures facilities to improving sustainable tourism, and determined their significance using the Geographic information systems (GIS). Furthermore, the uncertainty analyze was applied to diminish the inherent error in criteria weights. A GIS-based aggregation function was applied to discern the TPP map. Finally, the emphasis in this paper investigates the practical usage of GIS for the benefit of sustainable tourism development. In particular, it inquired the possible opportunities and challenges facing the adoption of GIS to assist sustainable tourism development. The purpose of this article is to map and explore existing and potential attractions, tourism services and facilities in Tabriz and to ensure that potential opportunities are available for all tourists to enjoy enjoyable experiences in order to reveal their diverse economic, social, political and cultural benefits. Build on the positive and negative aspects of their construction and present them with appropriate solutions for tourism development that lead to sustainable tourism development and infrastructure improvement.

Keywords: Mapping, sustainability, Tourism, GIS, Decision Making, Tabriz.

1| Introduction

Tourism has always been and will remain a way for the development and prosperity of all countries in the world, and it is an important factor in the use of natural and human resources, cultural resources, traditions and local customs, which connects people from all over the world. And it causes profit and creates employment. And entrepreneurship becomes for communities. It is also not only a driving factor for local and regional economies, but also a catalyst for all activities that tourism companies are directly and indirectly related to. Therefore, the economic, social and environmental performance of tourism companies is an important driving factor for the entire local, regional and global economy (Giano et al., 2020).

According to the latest news announced by the United Nations World Tourism Organization, the number of international tourists has exceeded 1.4 billion people, while the total export income from international tourism has reached 1.7 trillion dollars (about 2% of global GDP). In terms of tourism destinations available at the global level, Europe is still a magnet for any type of travel, and here we can mention cultural tourism, beach tourism, skiing, spa and finally business tourism. As a tourist destination, Europe continues to be a world leader in terms of income and number of travelers, as well as important positions in terms of economically developed countries, quality of life and achievement of sustainable development goals (receiving half of the world's international tourists) (UNWTO, 2018).

Since the influence of sustainable development on the future of the world is very important, every industry is trying to discover a solution for sustainability according to the potentials and capabilities of its country. Sustainability "focuses attention on a set of values and ethical principles that guide action in a responsible and coordinated manner and that includes the environmental and social consequences of actions as well as economic goals" (Kishi, 2019: 1). The prefix "sustainable" is currently used in different issues such as tourism, architecture, agriculture and community development (Butcher, 2017). Therefore, sustainability has become one of the most basic strategic subjects for lots of industries. For instance, the tourism industry is recognized as one of the most important economic activities in the world that has a major impact on local communities in tourist destinations (Anne Vourch & Richard Denman, 2003: 7). It generates one in ten jobs worldwide (WTTC, 2019), and is now want to go towards sustainable tourism. Furthermore, much has been reported about the positive and negative impacts of tourism, including political, environmental and ecological, socio-cultural and economic aspects, and has created challenges in the industry (e.g. Archer and Cooper, 1998; Archer et al. et al., 2005), which leads to some questions. Based on the potential of tourism to create changes and favorable development (Moufakkir & Kelly, 2010: 20).
So, the sustainable concept of tourism must support the long-term goals of economic, social and environmental development If tourism is not properly planned and managed by the government and

stakeholders, it will cause serious damage to the physical, social, cultural, political and economic environment of a tourist destination (Edgell et.al, 2008: 7). This is why paying attention to sustainable tourism is a fundamental subject. Reasons such as the destruction of the environment caused by global warming, the fading of social values and the destruction of natural, historical, social and cultural assets make attention to sustainable tourism a necessity. Some social issues such as overpopulation, environmental destruction, traffic congestion, reduction of quality of life and cultural destruction have been given more attention. These issues can be defined as "tourism overcapacity", which means that the level of tourism development exceeds the maximum limit (Wang et al., 2019:1). Therefore, tourism planning requires the development or upgrading of infrastructure such as roads, water and electricity, which are shared between tourists and local people and are needed to improve the living conditions and satisfaction of tourists. As a result, with tourism planning and development, local people are more motivated to improve their property for tourist use, thus benefiting from increased value (Frey and George, 2010: 623). It goes without saying that the market economy alone does not lead to sustainable tourism and the development of sustainable tourism requires government intervention. Because the governments have sufficient and legitimate power to create political stability, improve all-round infrastructure, security and legal and financial framework to facilitate the process and development of tourism (Zargham Borojni and Shalbafian, 2015: 137-138). Today, many countries derive their economic and social benefits from investing in the tourism sector and use the profits to develop their infrastructure (Eccles and Costa, 1996). Also, the development of tourism for developing countries that are involved with problems such as high unemployment, limited foreign exchange reserves and single-product economy, is of great importance and needs planning (Majnouni and Soleimani, 2016: 42). According to the World Trade Organization, "sustainable tourism development meets the needs of current tourists and host regions while protecting and enhancing opportunities for the future."

The Definition of Sustainability

Sustainability is one of the important and basic concepts in urban development that was raised in the early 1990s, which was hegemonic (Campbell, 1994). Sustainability can be assumed to be tangible, but it is strangely difficult to define. Researchers want a clear definition of sustainability (Hylten, 2020), but this concept still remains ambiguous due to its many interpretations, meanings and applications (Chang, et al. 2017).

The Importance of sustainable development

Sustainable tourism development meets the following requirements (Anne Vourc'h & Richard Denman, 2003: 7): • Tourism resources - natural, historical, cultural, etc. - are preserved in such a way that they can be used in the future. he does. While it is for the benefit of today's society. • The planning and management of tourism development is done in such a way as to prevent the creation

of serious environmental or socio-cultural problems in the target area. • The overall quality of the environment in the tourist region is protected and improved if necessary. The level of tourist satisfaction must be maintained to ensure that destinations remain attractive and maintain their commercial potential. and • Tourism should benefit all members of society to a large extent.

Tourist Destinations

We learned about the five sectors of the tourism industry and how they work, and we also studied tourism products. And we found out how different parts of tourism are connected with each other to meet the needs and desires of travelers (Anthony Camilleri, 2019: 19-20).

Main Components of Tourist Destinations

Regardless of why and how travelers travel, there are some basic and essential needs that they expect from the tourist destination they choose. Tourism researchers believe that there are several main components that are needed for the success and development of a tourist destination. These are commonly known as the 5A's - access, accommodation, attractions, activities and facilities.

access: In order for a destination to be usable for tourists, there must be different ways to reach the country, the region and the possibility of accessing the existing attractions. This doesn't mean that luxury or mass transit should be available for everything, but it does mean that access to all the sights should be as accessible as possible. Accessibility refers to transportation, but it can also simply refer to a walking path or a bike path.

accommodation: If tourists are going to stay in a tourist destination for more than one day, they must have a place to stay and rest. Therefore, tourist destinations should offer a variety of accommodation facilities and facilities, in terms of different price ranges and suitable for each class of travelers. Sometimes, lodging is almost part of the attraction of the destination, especially if it overlooks a scenic spot or landmark.

attractions: Tourists rarely travel to a destination with the sole purpose of staying in a specific accommodation. They usually travel to see what the destination has to offer them that is special and different from other tourist destinations in terms of what they can see, do and experience. The characteristics that attract a person to a particular destination are called attractions. Attractions include natural attractions based on natural and environmental features, historical-cultural attractions based on human activities, and artificially created special attractions.

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Theme	Sub-theme	Theme	Sub-theme
Tourism attractions	Historical homes	Hospitality accommodations index	Hotels
	Shopping centers		
	Recreation center		
Service facilities	Travel agencies	Availability of infrastructures	Access to restrooms
			Health and sanitary centers
	Restaurants		
	Super markets		Police stations
	Access to parking		Access to bus stop
			Access to subway
			Access to taxi stations

Source: Inskeep, 1991 Table (1): Classification of research criteria

activities: Many tourists like to do some activities themselves in the destination and enjoy. These activities include shopping, eating, picking fruit from trees in agricultural gardens, using sports facilities, and participating in outdoor recreational trips (among other activities).

amenities: Among the amenities and facilities of tourist destinations, we can mention electricity and water supply, sanitary services, safe drinking water, roads, police and emergency services, postal and communication facilities, media, etc. The important thing is that these services and their quality ensure that tourists stay in a healthy and safe destination during their stay. Tourists should have access to basic facilities to feel comfortable. If tourists receive a positive image of the tourist destination, the possibility of returning and promoting it to other friends and acquaintances will increase, and this will promote the tourism of that country.

2 | study area

The progress and reaching the field of tourism in any country depends on the ability of that country to develop, manage, plan and market tourism facilities and activities in that country. Most of the developing countries mainly turn to tourism for their economic growth and diversification and are trying to improve their facilities and services. During the twentieth century, Tabriz was the most strategically and geopolitically important city; still in the 21st century, Tabriz has maintained its historical role as one of the most important cities in Iran (Lorentz, 2007: 323). That is, today, thanks to its diverse functions politically, economically, militarily and not only is one of the most important cities in the country, but also has a wide area of influence at regional, national and transnational levels (Pashapour et al., 56: 2013). According to the East Azerbaijan Tourism Master Plan, the city of Tabriz has features such as Europe-East Asia (Silk Road) and Europe-Tehran communication route, international airport, natural and historical attractions in the region, a long history of facilities. The infrastructure is the main centerpiece of the province's central tourism center. Nowadays, Tabriz is one of the most beautiful and historic cities in Iran. The main attractions of this city can be divided into two categories: 1) historical and ancient attractions, 2) cultural and artistic attractions (Timuri et al., 2014: 70). Among the cultural and artistic attractions of the city are handicrafts, international fairs, needlework, carpet weaving, copper engraving, shoe making, carving, embroidery, carpet weaving, engraving, inlay, ceramics, jewelry and pottery, silverware, pottery. (Salehi, 7: 1396). It also has good facilities due to the centrality of the province and its history and civilization. According to the Supreme Council of Architecture and Urban Development of Iran, as one of the six cultural and historical cities in the country, it is one of the oldest origins of urbanization and civilization in the country with a very rich and extensive historical and cultural heritage that has high potential for cultural enrichment and tourism expansion. (Adami, 4: 1394). Also, this city has been selected as the tourism capital of Islamic countries according to the decision of the Organization of Islamic Cooperation in 2018. According to historians and tourists, in the centuries after Islam, Tabriz was not only one of the most important and prestigious cities of Azerbaijan, but also one of the most important cities of the country. The crossing of the Silk Road has given rise to economic and cultural flourishes, and political, economic and cultural links have transformed the culture of civilization and customs of the people of this land, setting the stage for the creation of many science and schools, institutions and civil institutions for the first time. It has brought the country and raised the name of Tabriz as the first city in the country. It was the first school, the first library, the first hospital, the first publication, the first theater, the first baldia, and so on. Natural and Cultural and Historical Attractions of Tabriz Town El Goli Tabriz, Azerbaijan Museum, Municipal Museum, Museum of Natural History, Qajar Museum, Iron Age Museum Site, Pottery Museum, Tomb of Al-Shara, Measurement Museum, Quran and Books Museum, Mashroote House , Tabriz market, Alishah citadel, Golestan garden, Goori Gol wetland, Sultan Daghi heights, Sahand heights, Islamic island or Shahi, Tabriz churches and Tabriz

cathedral, Tabriz Haj mosque and Kaboud mosque and ... (Cultural Heritage, Craftsmen And Tourism in East Azerbaijan Province: 2018).

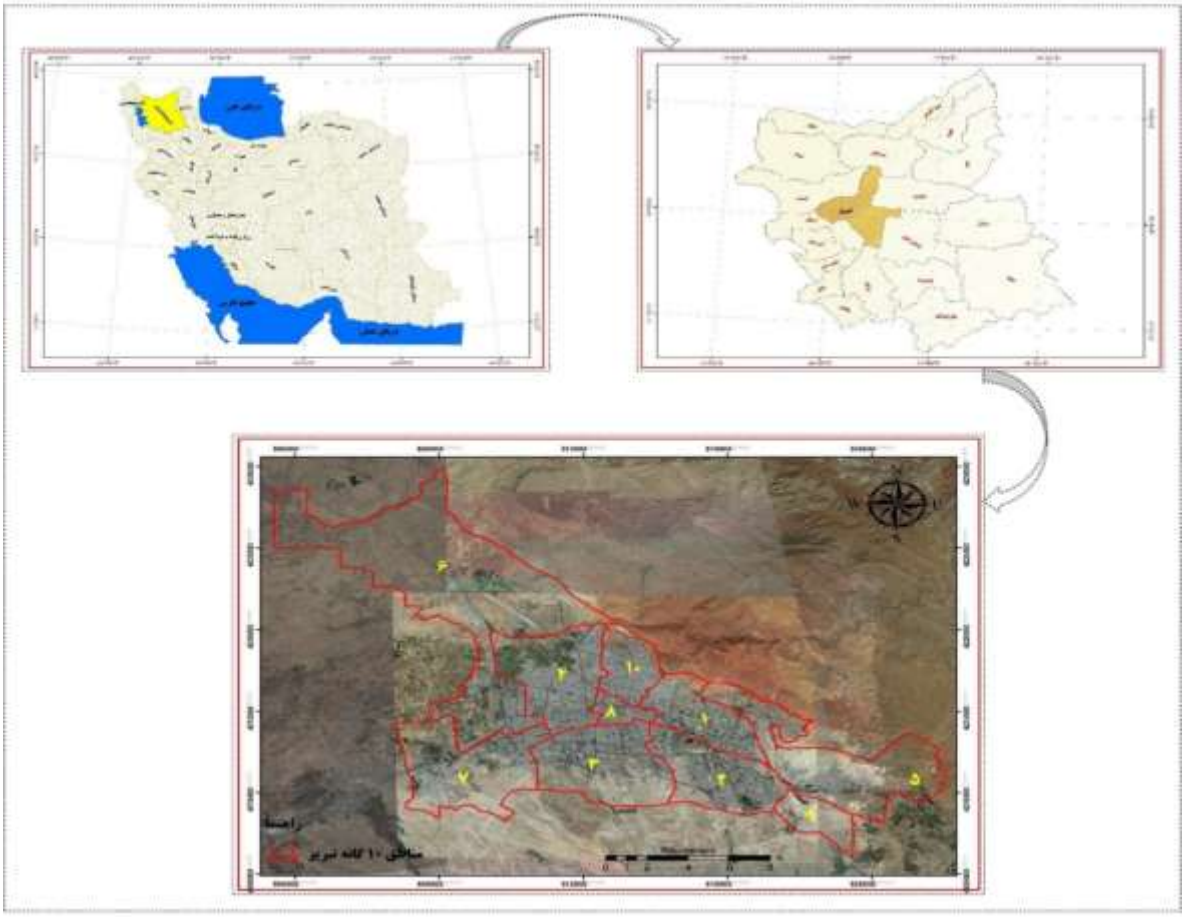

Figure (1): Study area

In the present study,

3 | Materials and methods

3.1. Data collection and processing

The research methodology for the spatial modelling of tourism products potentials is based on GIS-MCDA techniques. Table. 2 shows the main research methodology schema. To achieve the research goals, a set of data related to the potentials required for sustainable tourism development has been used and for this purpose, according to the criteria set for the research, data has been collected. Part of the data required for the research has been extracted from the land use map of Tabriz in the form of a digital layer using ArcGIS software, and by fixing the errors in the mentioned data, editing operations have been performed on them. Also, due to the lack of access to some of the required data, using field studies and using Google Earth Pro software, digitization and extraction of the said data and their preparation for analysis operations have been attempted. Then, using Expert Choice 11 software, weighting operations to the criteria is on the agenda. Finally, using the Distance Euclidian command in Arc GIS software, the operation of converting data from vector mode to raster has been done.

3.2 | Extraction of weights

Multi-criteria analysis methods are well-known decision support tools used in connection with decision-making on complex issues involving technological, economic, environmental and social aspects (Rajabi et al., 1390). One of the most common methods used in spatial multi-criteria decision making is the AHP method proposed by Sati (1977). Hierarchical analysis method is used for a variety of topics that include complex multi-level criteria and there is also interaction between criteria. Accordingly, analysts can choose the AHP method to perform pairwise comparisons between criteria and thus reduce the existing cognitive limitations in determining the relative importance of criteria (Feizizadeh et al., 2014). AHP has the ability to turn complex problems into a series of pairwise comparisons, and it can be used to examine variables in the form of a matrix that provides a clear logic for ranking criteria based on their importance (Feizizadeh and Balshake, 2013). To perform pairwise comparisons, it is necessary to have a numerical scale that indicates the importance or superiority of one element over another, which are compared according to certain conditions (Table 2).

Table (2): Relative Significance Scale of Multi-Criteria Elements (Sati, 2008)

scale	Level of Significance	Interpretation
۱	Equal	The two elements have an equal share of the analysis problem.
۲	Insignificant	
۳	average	The analyst's experience and judgment give one element a slight advantage over another.
٤	Relatively high	
٥	high	The experience and judgment of the analyst lead to the dominant superiority of one element over another.
٦	Very much	
۷	Extremely high	One element has a very strong advantage over another.
۸	Impressive	
۹	extreme	One element explicitly has the highest advantage over another.

A basic method in the hierarchical analysis test is the binary comparison method. This method has three main steps in the implementation process of GIS software: a) Production of binary comparison matrix, b) Calculation of benchmark weights, c) Estimation of compatibility ratio (Sheriff and Property, 2014).

For determine the priority of the criteria and to perform pairwise comparisons, it is necessary to use expert opinions and evaluate the opinions of experts regarding the studied criteria in the weight range of 1 to 9. In this way, the relative importance of the criteria can be determined (Tables 3 and 2).

In order to normalize and calculate the relative weights of each option, the pairwise comparison matrix of the approximate method has been used. This method is done in three steps as follows:

1. Add the values of each column of the even matrix;

3. Divide each element of each criterion by the sum of the matrix columns;

2. Calculate the arithmetic mean of the elements in each row of the matrix.

In applying the AHP method, it is necessary that the weights extracted from the pairwise comparison matrix are compatible. Therefore, one of the strengths of AHP is that it provides the possibility of

achieving a compatibility ratio (CR) as an indicator of determining compatibility or incompatibility for the relationships of variables (Feizizadeh et al., 2014).

To calculate the compatibility ratio of comparisons, various relationships can be used as follows:

$$\mathrm{CR} = \frac{CI}{RI}$$

Where CI is the matrix compatibility vector and is obtained from the following equation:

$$\mathrm{CI} = \frac{\lambda\,\mathrm{max} - \mathrm{n}}{\mathrm{n} - 1}$$

Where λmax is the largest value of the specific vector of the matrix. RI is also a random index of the matrix and depends on the number of criteria in the matrix under study and its value increases with increasing the number of criteria.

The acceptable limit for the compatibility ratio of even matrices is 0.1, and in other words, if the CR is less than 0.1, the calculations have the desired accuracy and validity.

In the present study, the compatibility ratio for the calculations has an acceptable value. After pairwise comparisons and assigning the resulting weights to the layers, the desired integrated map is created with the overlap operation and from the Sum Weighted command (Figure 2).

Distances	Historical and Cultural attractions	hotels	Access to parking	Access to restaurants	Shopping centers	Recreation center	Access to restrooms	Health and sanitary centers	Taxi Station	Police stations	Access to subway	Travel agencies	Access to bus stops	Super markets	Relative weight
Historical and Cultural attractions		2	1	2	1	3	2	1	2	2	1	2	2	2	.105
hotels			2	3	2	2	1	2	3	1	2	1	2	2	.107
Access to parking				2	3	1	2	2	2	2	2	2	3	3	.106
Access to restaurants					2	2	2	3	1	3	2	2	2	2	.093
Shopping centers						2	2	3	2	1	4	3	3	3	.095
Recreation center							3	2	3	2	5	5	2	2	.097
Access to restrooms								2	2	2	3	4	3	2	.076
Health and sanitary centers									3	1	2	3	4	5	.070
Taxi Station										2	1	2	2	4	.053
Police stations											2	2	5	2	.060
Access to subway												1	2	3	.042
Travel agencies													2	2	.038
Access to bus stops														3	.032
Super markets															.027
Inconsistency	0.09														

(3): Matrix of pairwise comparisons of main criteria Table

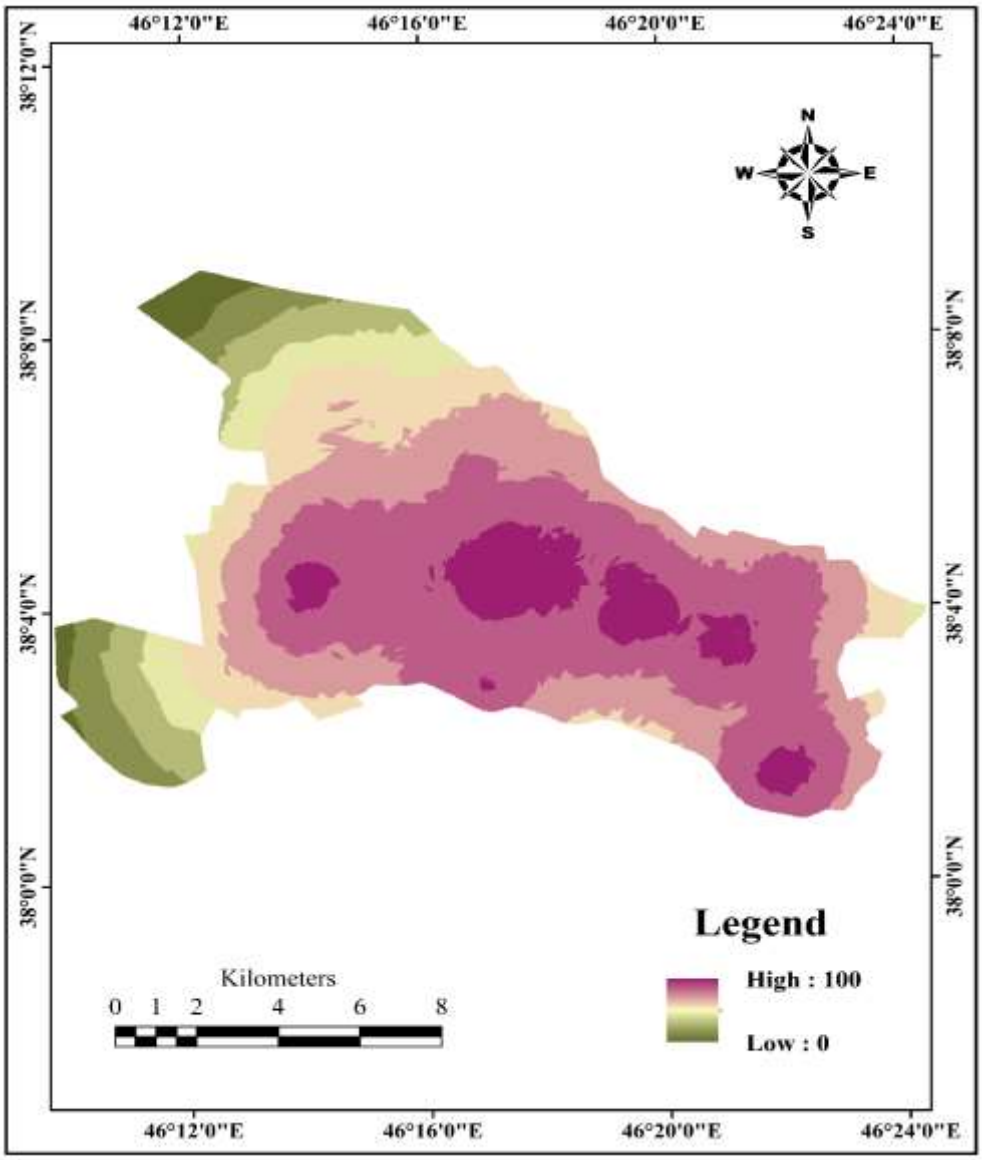

Figure (۲): Overlap map with AHP method

3.3 | Analysis of benchmark weights

Preliminary multi-criteria analyses usually have some degree of uncertainty and it is necessary to review the defined judgments and criteria to correct the errors in the heart of the problem. Error control and uncertainty in spatial multi-criteria analysis play a significant role in the decision-making process, which is done by making fundamental probability-based decisions against definite results (Feizizadeh et al., 2014).

Uncertainty can be defined as doubt, skepticism, or lack of certainty about something, and it can be defined as a lack of uncertainty and explicit knowledge about the results or output of the model. Uncertainty is propagated by the models used and from the data and input parameters to the results of the analysis (Abbaspour et al., 2003). Uncertainty analysis and sensitivity analysis are essential for modeling and in whatever context the model is used (Crosto et al., 2000).

3.3.1 | Uncertainty analysis

Uncertainty analysis tries to determine the reliability values for the model output and evaluate the response of the input parameters to the model uncertainty. There are several methods for analyzing the uncertainty of spatial variables. Simulation is one of the best methods for analyzing uncertainty in relation to location-based models that can be implemented without the need for background knowledge about error performance (Tannery and Carver, 2012).

The Monte Carlo simulation method is a mathematically framed method that transforms uncertainties in model input variables into probabilistic distributions. This technique randomly selects the values of the input variables and, with a series of recalculations, performs a simulation operation several times and displays the output values in the form of probabilities (Gay et al., 2013). Monte Carlo simulation in the form of AHP matrix can help to eliminate the shortcomings of multi-criteria analysis. The Monte Carlo simulation is performed using the following equation:

In this regard, Cij is a pairwise comparison ratio and P / (1- Pi) is the ratio of preference criteria.

In the present study, the following measures have been performed to perform the uncertainty analysis using the Monte Carlo method:

- Production of training sample points: These points can be created randomly with the Random Create function or can be harvested optimally and in accordance with the desired criteria. Here, using Google Earth, samples have been taken, emphasizing all the researched criteria, and after digitization and definition of the coordinate system, it is ready for further processing.

- Extracting the value of layers: For this purpose, using the Vector to Attribute Raster Add function, the values of raster layers are extracted based on educational examples and stored as a new column in the information table of the desired layer. The resulting values for each layer are shown based on the raster value of that layer and for the pixel on which the sample is located.

- Standardization: Due to the fact that the values obtained in the previous step are asymmetric and without scale and the data may not be compatible with each other, so with the Field Standardize command, these values are converted to fuzzy scale and the value range is between 0 and 100 It is defined for them. Also, at this stage, the type of research criteria should be determined based on their importance in the issue in question, for which the criteria are classified into two types: Benefit and Cost. For Benefit criteria, the maximum layer value is considered and for Cost criteria, the minimum layer value is considered.

Weighting: Using the weights assigned by AHP method (Table 3), each layer has received the relevant weight. Then the simulation operation was performed 100 times and finally the results were produced in the form of maps and statistics. The calculated statistical values include average rank, minimum rank, maximum rank and maximum deviation of Rank Deviation Standard. These statistics are directly related to the degree of uncertainty of the data in question, and the greater the standard deviation, the higher the spatial uncertainty. The spatial uncertainty map for the desired criteria is based on the average (Figure 3).

By specifying the values of spatial uncertainty, in the next step, we can correct the errors in the weight values of the parameters based on separate criteria.

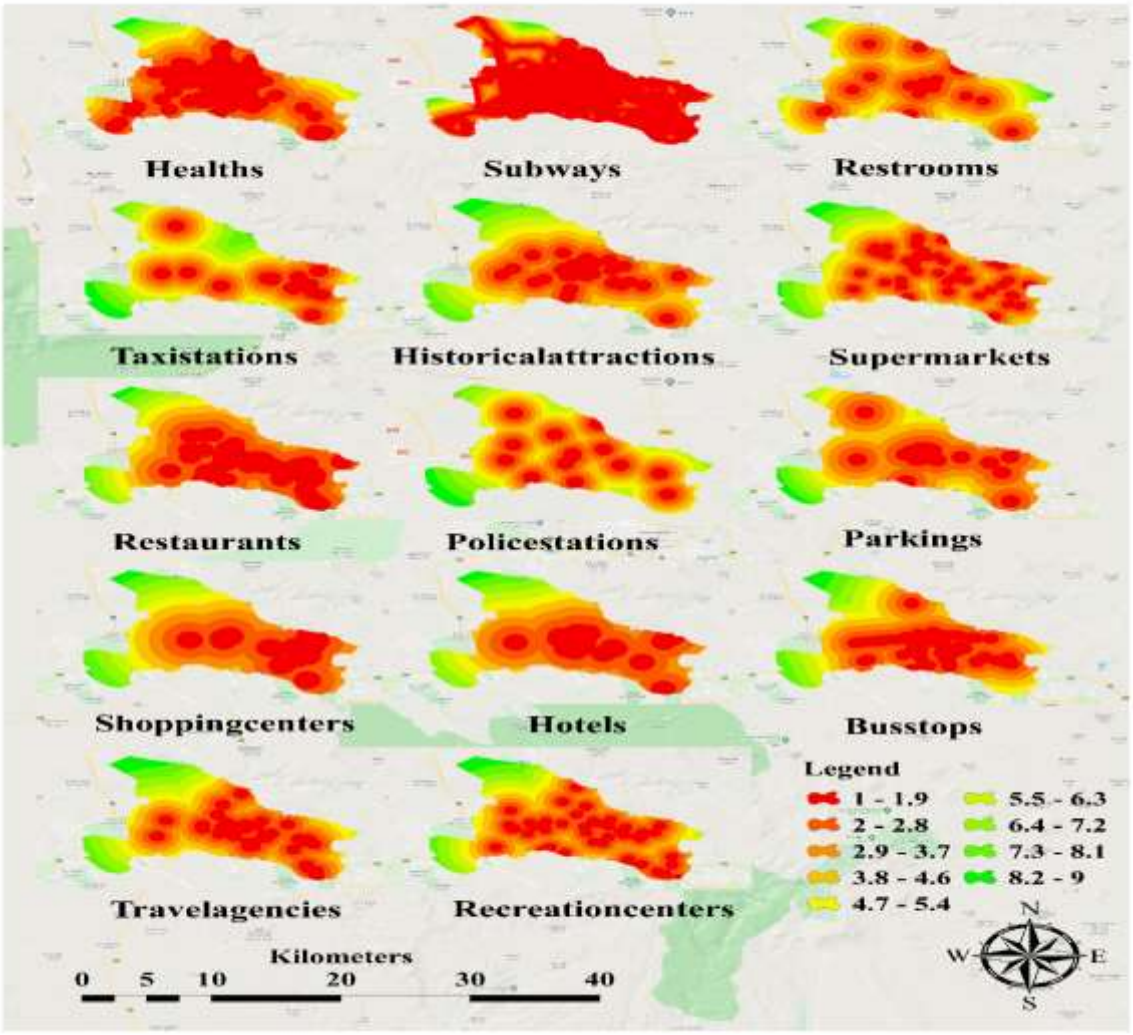

Figure 3: Map of spatial uncertainty

4 | RESULTS

According to the resulting map, the density of tourism facilities and facilities in Tabriz city can be divided into three classes: poor, medium and favorable (Table 4). Based on this, urban area 8 has the most facilities and tourist facilities and urban area 6 has the least facilities and tourist facilities. In general, it can be concluded from the mentioned map that the central areas of the city have a high capacity to receive tourists due to the concentration of the old context and service and commercial facilities, and the level of access of tourists to tourism facilities and services in this area is higher than in other areas. Therefore, the potential of tourism in the 8th region of Tabriz city is more and we should strive to preserve and improve the quality of historical monuments and other tourist attractions in it and preserve it for future generations.

Table 4: Analyzing the state of urban readiness in terms of tourism

Row	Name of the region	Area of the region (square kilometers)	The level of tourism facilities and services
1	Region One	۱۶/۱۰۲	Favorable
2	Region Two	۲۱/۰۴۸	Favorable
3	Region Three	۲۷/۰۷۹۶	Medium
4	Region Four	۲۵/۲۹۴۶	Medium
5	Region Five	۳۵/۶۹۲۱	Poor
6	Region Six	۸۴/۴۰۶۳	Poor
7	Region Seven	۲۹/۵۰۸۹	Poor
8	Region Eight	۳/۸۵۳۸	Favorable
9	Region Nine	۷/۸۷۱۵	Poor
10	Region Ten	۱۰/۸۸۶۳	Favorable

Figure4: Zoning map of the degree of readiness of urban area

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