Spatial assessment of natural conditions for recreational tourism in the mountains of Tashkent region

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Abstract. This paper is about the use of tools of spatial analysis for assessing the natural conditions for recreational tourism in the mountains of Tashkent region. For this study maps of topography, landscape, and risks of avalanches are recompiled for the development of the database. Assessment is based on accepted criteria for evaluating the capacity of the region for recreational tourism. According to these criteria, the spatial analysis procedures were carried out. The general scheme of the GIS-based evaluation process is developed and tested. As the result of spatial assessment 5 major zones were identified. The result of the spatial analysis is the map that defines the spatial extent of suitable areas for short-term recreational tourism.

1 Introduction

Recent reforms in the touristic business emphasize the importance of the spatial assessment of the capacity of natural resources. From this perspective, the geospatial approach provides the best tools [1-5] for defining the opportunities for further development of sites of particular interest. Research [1,3-6] uses GIS-based spatial tools for assessing the conditions of development of different types of tourism. The frequently used approach is the development of an evaluation system with such parameters as resource conditions [1,2,4], difficulty levels [5,6], safety conditions [7-9], and ecological sensitivity [10]. Authors [8,13] note the importance of developing touristic activities in the mountains of Uzbekistan. However, a spatial assessment of the mountainous areas and their suitability for recreational tourism depending on elevation was not carried out. The mountains of the Tashkent region are rich with attractive sites for different kinds of long-term and short-term recreational tourism for educational, leisure, and sports purposes.

The spatial assessment of natural conditions is a way to evaluate the capacity for recreational tourism of different types. The attractiveness of sites is dependent on several natural factors. The purpose of this study is to conduct the suitability assessment of some

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natural conditions for recreational tourism in the mountains of the Tashkent region. In the arid climate conditions of Uzbekistan, altitudinal zonation (or elevational zonation) in mountainous regions is a significant feature to define the natural layering of ecosystems. The suitability for short-term recreational tourism is dependent on varying environmental conditions and ecosystems that occur at distinct elevations. The vertical zonation of landscapes [11] intrinsic to the nature of the Tashkent region is an important characteristic that diversifies attractiveness and raises interest in visiting sites. It is assumed that topography plays a major role in the suitability of short-term recreational tourism. Meanwhile, in mountains, risks exist and the major of them is the risk of avalanches. In this study, several criteria are developed to spatially assess the natural conditions of each type of recreational tourism. The criteria are 1) elevation; 2) steepness of slope; 3) landscape type; 4) risk of avalanches; 5) probability of a severe earthquake.

2 Materials and methods

The term landscape commonly means "the geographic features that mark or are characteristic of, a particular area" [12]. The landscape is a single natural-territorial complex that includes the following main components: geological structure, relief, climate, water, soil, and vegetation. In this study, maps of topography, landscape, and the risks of avalanches, are used as the main data sources for spatial analysis [14, 214-215].

Data derived from the above-mentioned sources is processed with the help of standard QGIS procedures:

- georeferencing and adjusting to the comparable DATUM WGS84 and modified polyconic cartographic projection.
- defining the criteria of assessment.
- developing the model of geoprocessing.
- geoprocessing with the help of tools of spatial analysis.
- final assessment based on applied criteria.

The criteria for assessing the suitability of objects for short-term recreational tourism are determined according to these rules:

- the suitability of the topography and steepness of the slope for short-term recreational tourism;

it is accepted that certain types of terrain and landscape are more attractive due to their favorable conditions. They are 1) accumulative and 2) piedmont proluvial and alluvial-proluvial plains, 3) low mountains; 4) piedmont low mountains and hills.

- the elevation is considered the main criterion that determines the spatial extent of the attractiveness of a destination for short-term recreational tourism. The distribution of flora and fauna and the attractiveness of the site are affected by elevation. For the assessment of suitability, elevation was divided into 5 clusters.

- five main areas of suitability for recreational tourism have been identified depending on the complexity of the surface, landscape, and avalanche danger. It is accepted as a five-level classification method, with a score of 1 being "not suitable" and 5 being "suitable" (Table 1).

The system of criteria for the assessment of natural conditions is developed with the consideration of the spatial distribution of the particular types of topography, landscape, and risks (Table 1, Table 2, Table 3).

Table 1. Criteria for the assessment of the suitability of natural conditions for recreational tourism Compiled by authors according to data derived from [14].

№	Score	Natural conditions				Classification of suitability	Type of the recreational tourism
		Elevation, m	Types of Landscape	Risk of avalanches	Risk of earthquakes		
1	5	Up to 500	Plain	*No risk*	Weak	Suitable natural conditions	short-term recreation of all types
2	4	500-1500	Pre-mountain plains and intermountain depressions, hills and low mountains	*Weak*	Weak	Suitable natural conditions	Cognitive tourism, cycling tourism, summer mass recreation, water activities, water sports, fishing
3	3	1500 – 2500	The forest-meadow-steppe zone of moderately high mountains	*Average*	Average	Suitable natural conditions	Hiking, educational tourism, inpatient recreation, and one-day walking routes. Stationary recreation, individual seasonal recreation. A multi-day route of varying difficulty.
4	2	2500-3500	A subalpine and alpine meadows of high mountains	*There is a risk of avalanches*	High	Not suitable	The steepness of the slopes limits the possibility of walking and recreation tourism.
5	1	Higher than 3500	The region of snow and ice (nival)	*Strong*	High	Not suitable	The region with a high risk of snow avalanches. Not suitable for recreation tourism.

The spatial analysis is carried out according to the rule "from general to specific". Standard procedures are used to define the area of different value for recreational tourism. The database was developed by combining relevant data. This is used for examining the locations of each of the 5 areas and their attributes. The overlay analytical technique is used in all stages of spatial analysis to determine the relationship between selected features. The general scheme of the GIS-based evaluation process is given in Figure 1.
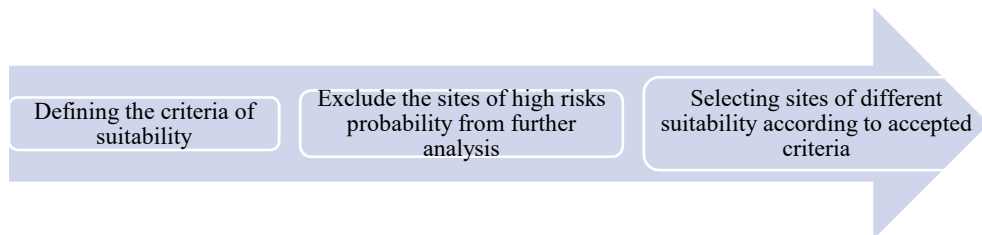
| Defining the criteria of suitability | Exclude the sites of high risks probability from further analysis | Selecting sites of different suitability according to accepted criteria |

Fig 1. General scheme of the GIS-based evaluation process.

Table 2. The landscape of Tashkent region. Compiled by authors according to data derived from [14].

Landscape		Plains		Mountains				
		Akkumulative	Piedmont proluvial and allyuvial - prolyuvial	Low mountains	Piedmont low mountains and hills	Moderately high mountains	High mountains
		lake	flat wavy	strong and weakly fragmented slopes			
		wavy	sand layers mixed lyoss	sandstones and sandstones in sands, marls, limestones, and bedrock			
		Clay and sand					
	Deserts	Wet deserts are saline deserts where saline plants grow (9)					
					wormwood-mixed bells on gray soils (65)		
	desert and arid steppe		irrigated lands and seliteb areas on gray meadow and meadow-alluvial soils (68)				
				dry and brown soils (73)			
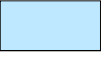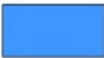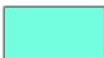
							Spruce in brown soils with sloping ridges (76)	
	Forest-meadow steppe							
	Steppe-meadow steppe and glacial-nival							Steppe and meadow-steppe complexes in high mountain soils (78)
								Glaciers, snowfields and rocks (79)

Table 3. The level of risk of avalanches. Compiled by authors according to data derived from [14]

No		Characteristics			
	The symbol on the map	Level of risk	Number of avalanches a year	Number of avalanche sites per kilometer	The damage rate
1		Strong	Snowfall is observed several times during the season	There are 5 or more landslide sites per kilometer of the main valley	The damage delivery rate exceeds 0.75
2		Average	Avalanches are observed every year	There are 2-5 avalanche sites per kilometer	The degree of damage delivered ranged from 0.25 to 0.75
3		Weak	In some avalanche sites, avalanches occur 1-3 times a year, but in most of them, avalanches are not observed.	There are 1-2 landslides per kilometer of the main valley	The damage delivery rate does not exceed 0.20
x4		There is a risk of avalanches	Under abnormal conditions, small avalanches can be observed	Avalanches are not observed	The damage delivery rate about 0
5		No risk	Areas without avalanche danger	Avalanches are not observed	0

Data are grouped according to accepted criteria with the purpose to organize the structured information for storing in a computer system (Figure 2, Figure 3).
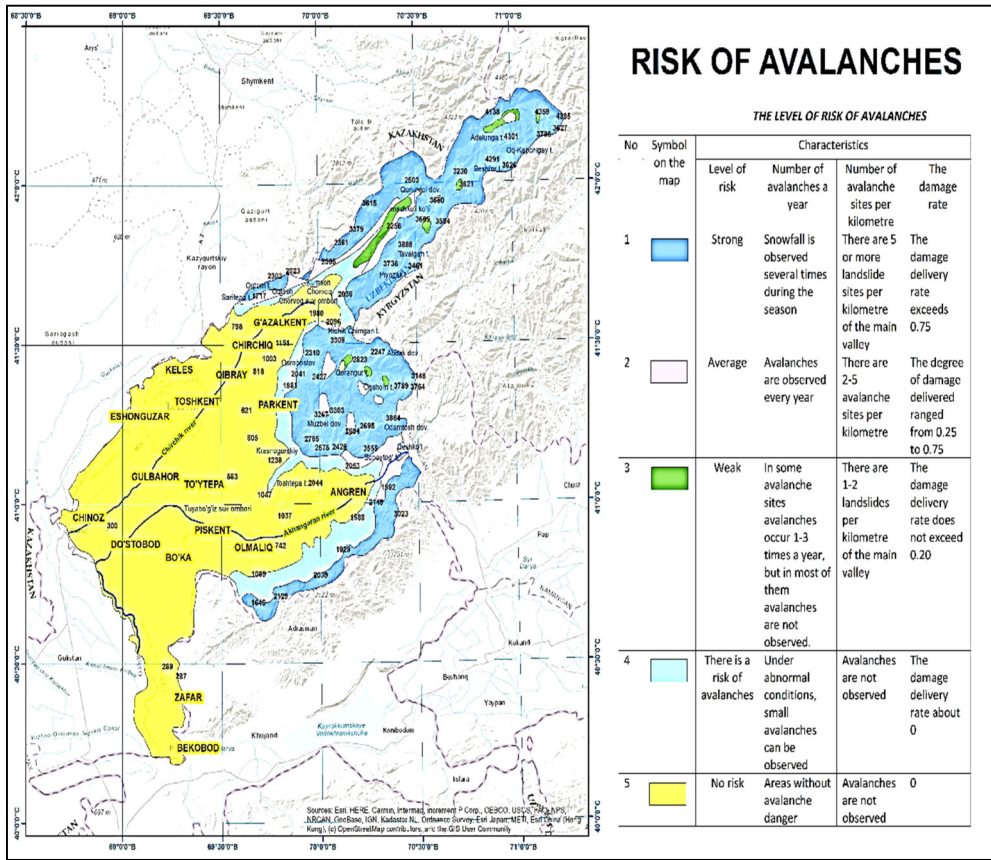
Fig. 2. Risks of avalanches. Compiled by authors according to data derived from [14]

The next steps of spatial analysis include the evaluation of relationships between topography and landscape features in spatial data by means of intersecting, union, and joint analytical tools with the purpose to check the extent of the area of the specified type of natural conditions for recreational tourism. All sites with high risks of avalanches are excluded from the spatial analysis procedures. A region of subalpine and alpine meadows of high mountains and the region of snow and ice (nival) are determined as not suitable for short-term recreational tourism. The boundaries of the zones were identified by comparing the relationships between landscape elements and their attractiveness for recreational tourism.

According to the criteria for assessing the suitability of natural conditions for recreational tourism (table 1) sites are scored. The high score is determined by the area at elevations up to 500 m and plain landscape.

Pre-mountain plains and intermountain depressions, hills, and low mountains at elevations of 500-1500 m are scored as 4. The forest-meadow-steppe zone of moderately high mountains at elevations 1500-2000 is scored as 3. Subalpine and alpine meadows of high cliffs at elevations 2500-3500 m are scored as 2. The snow and ice (nival) region at elevation is scored as 1.
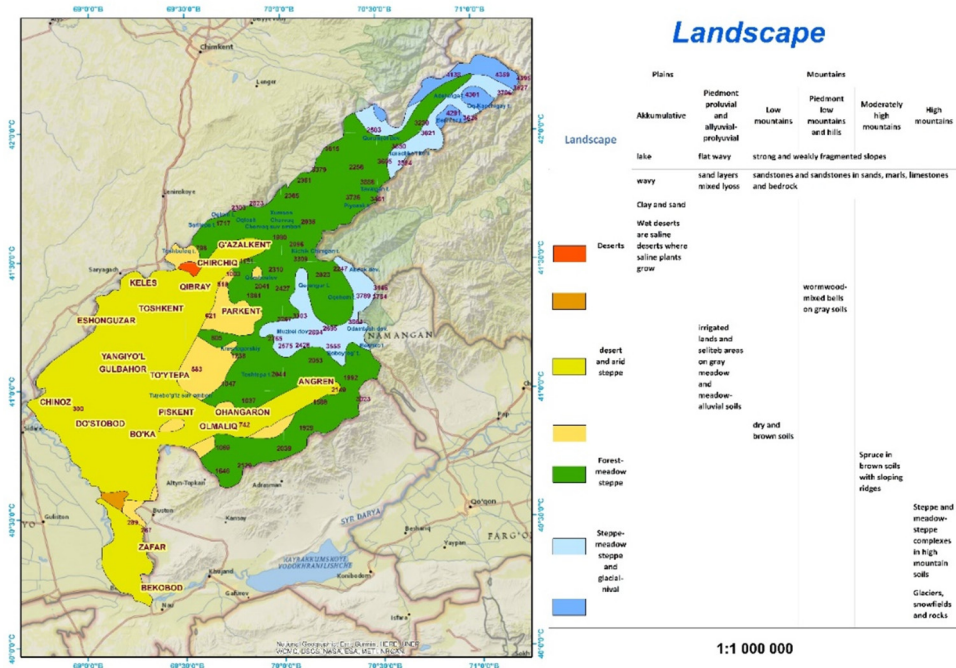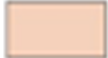
Fig. 3. Landscape types. Compiled by authors according to data derived from [14].

3 Results and discussion

The result of the spatial analysis is the output data that defines the spatial extent of suitable areas for short-term recreational tourism according to accepted criteria. Five areas are identified. Three of them are suitable for short-term recreational tourism, while two others limit the possibility of walking and recreational tourism and one is not suitable at all (Table 4, Figure 4).

The spatial analysis reveals that only in 3 regions the natural conditions are suitable for some types of recreational tourism. The extent of these regions is defined in relation to topography which is the main factor in this study. This factor plays a major role in attracting tourists, and it is used for assessment and defining suitability. However, the boundaries of some types of landscape do not coincide with the elevation. This makes defining the extent of suitability within low and medium mountains with some assumptions. The assessment has been conducted with consideration of some natural resources and the result of this assessment needs further clarification and more detailed analysis. At this stage of research, the general assumption is made on boundaries of suitability. It is well known that the development of recreational tourism requires intensive investment for construction in medium and high mountainous terrain. This research may be a starting point for spatial planning of recreational tourism. This method provides the tool to analyze the spatial relationship of various natural conditions. Further research is to expand the scope of data for spatial-temporal analysis which has not yet been conducted.

Table 4. Characteristics of the suitability for the development of recreational tourism.

No	Elevation (m)	Types of Landscape	Recreational tourism types
1	Up to 500	The lower desert is located at an altitude of 0-200 meters, the upper desert is at 200-500 meters high.	Landscapes with favorable conditions for some types of short-term recreation of all types
2	500-1500	Pre-mountain plains and intermountain depressions, hills in front of the mountains and low mountains in the foothills	Cognitive tourism, cycling tourism, summer mass recreation, water activities, water sports, fishing
3	1500 – 2500	The forest-meadow-steppe zone of moderately high mountains, lands are dominantly occupied by rocks, landslides	Hiking, educational tourism, inpatient recreation, and one-day walking routes. Stationary recreation, individual seasonal recreation. A multi-day route of varying difficulty.
4	2500-3500	A region of subalpine and alpine meadows of high mountains	Some types of Mountain Tourism. Separate ascent and difficult multi-day routes to get to the high-mountain zone. The steepness of the slopes limits the possibility of walking and recreation tourism.
5	Higher than 3500	The region of snow and ice (nival) includes the highest areas of the mountains, covered with glaciers, ice caps, and ice sheets. Its lower limit is 3600 m in the Piskom Basin	The region with a high risk of snow avalanches. Not suitable for recreation tourism. Skiing in winter.

MAP OF NATURE ASSESSMENT FOR RECREATIONAL TOURISM

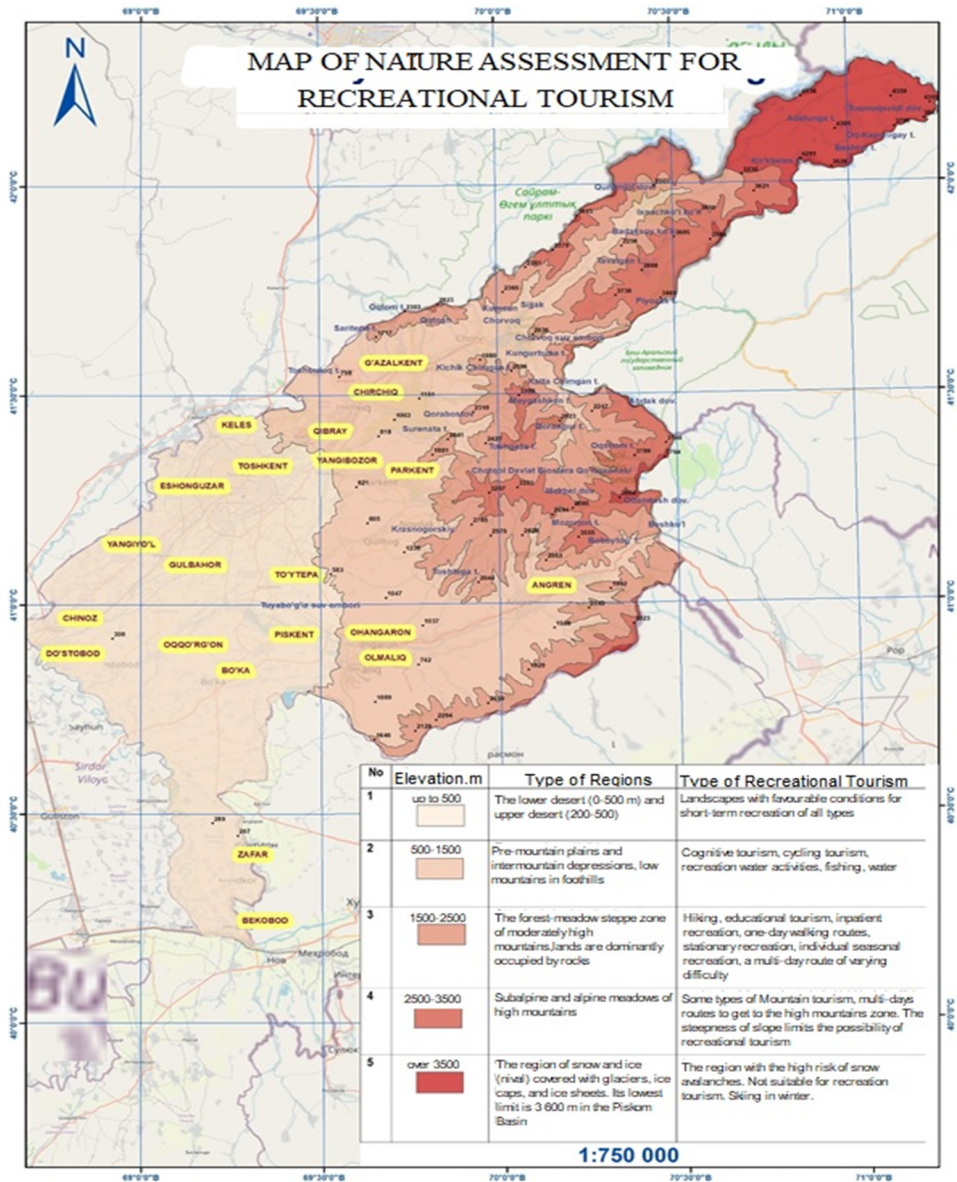| No	Elevation.m	Type of Regions	Type of Recreational Tourism
1	up to 500	The lower desert (0-500 m) and upper desert (200-500)	Landscapes with favourable conditions for short-term recreation of all types
2	500-1500	Pre-mountain plains and intermountain depressions, low mountains in foothills	Cognitive tourism, cycling tourism, recreation water activities, fishing, water
3	1500-2500	The forest-meadow steppe zone of moderately high mountains, lands are dominantly occupied by rocks	Hiking, educational tourism, inpatient recreation, one-day walking routes, stationary recreation, individual seasonal recreation, a multi-day route of varying difficulty
4	2500-3500	Subalpine and alpine meadows of high mountains	Some types of Mountain tourism, multi-days routes to get to the high mountains zone. The steepness of slope limits the possibility of recreational tourism
5	over 3500	The region of snow and ice (nival) covered with glaciers, ice caps, and ice sheets. Its lowest limit is 3 600 m in the Piskom Basin	The region with the high risk of snow avalanches. Not suitable for recreation tourism. Skiing in winter.

1:750 000

Figure 4. The result of spatial analysis of the suitability for short-term recreational tourism.

4 Conclusions

The method is tested for spatial assessment of natural conditions of recreational tourism. The spatial analysis provides the analytical tools for dealing with data for getting geospatial information about the suitability of natural resources for some types of recreational tourism in the mountains of the Tashkent region. This approach may be improved by adding data on other natural and social conditions. The efficiency and accuracy of spatial analysis may be raised by involving more detailed data on the environment and society. This study is aimed to find out a simple tool for spatial assessment of the recreational resources of mountains.

Elevation, landscape type, and avalanche data sets were used to determine the main factors influencing the spatial development of recreational tourism using QGIS software. By using limited data derived from the maps, this study shows the opportunities for sophisticated spatial analysis of suitability for recreational tourism. The inclusion of data on detailed specific features of topography like an exposition of slopes and gradients of steepness is the preferable way to improve analysis. The analysis of the spatial distribution of social infrastructure and transportation networks may provide the assessment of accessibility and enrich the results of spatial analysis. This study helps to define the spatial extent of perspective sites for short-term recreational tourism. These sites are the object of further more detailed research.

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