UDC 656.079:35.073

Nizomova Risolat Raximjon kizi

PhD student, Senior Lecturer

Tashkent State Technical University, Tashkent, Uzbekistan

GEOINFORMATION METHODOLOGY FOR ASSESSING TOURISM POTENTIAL BASED ON ENVIRONMENTAL FACTORS

Abstract: *This study proposes a GIS-based methodology for assessing tourism potential using environmental factors such as vegetation, water resources, landscape naturalness, protected areas, and anthropogenic pressure. GIS, remote sensing, and multi-criteria analysis are integrated to identify suitable tourist areas and support sustainable tourism planning.*

Keywords: tourism potential, environmental factors, GIS-MCDA, remote sensing, AHP, sustainable tourism, cartographic modeling.

Introduction. Environmental sustainability is increasingly important in tourism development. Tourism potential depends not only on attractions but also on vegetation, water resources, landscape condition, protected areas, and anthropogenic pressure. Therefore, environmental factors should be spatially assessed using an integrated approach [1].

GIS-MCDA, AHP, Fuzzy-AHP, and remote sensing are widely used to assess tourism and ecotourism suitability. These methods effectively integrate environmental and spatial indicators to identify suitable tourism areas [2]. In Uzbekistan, GIS-based assessment of natural-geographical factors is also relevant for sustainable tourism planning.

The aim of this study is to develop a GIS-based methodology for assessing tourism potential using environmental factors and to map environmentally suitable areas. The main objectives are to identify key environmental factors, create a spatial database, standardize and weight indicators, calculate an integrated tourism potential index using GIS-MCDA, and zone territories according to environmental suitability for sustainable tourism planning.

Research methodology. The assessment uses remote sensing data, DEM, hydrographic data, land-cover and land-use information, protected-area boundaries, roads, and tourist attractions. Sentinel-2 and Landsat data are used to assess vegetation and land cover, while DEM provides elevation, slope, and aspect information.

Environmental factors are divided into positive and negative groups. Positive factors include vegetation, water bodies, natural landscapes, biodiversity, and protected areas. Negative factors include pollution, anthropogenic pressure, erosion, degradation, and environmental hazards [3].

Indicators are standardized using min-max normalization:

$$\textbf{Positive: } Xi' = (Xi - Xmin) / (Xmax - Xmin)$$

$$\textbf{Negative: } Xi' = (Xmax - Xi) / (Xmax - Xmin)$$

The integrated Environmental Tourism Suitability Index is calculated as:

$$\mathbf{ETSI = \Sigma(Wi \times Xi')}$$

where Wi represents the factor weight and Xi' the standardized indicator value. Weights can be determined using AHP or expert assessment, and the final index can be calculated in GIS using Weighted Overlay [4].

Environmental Factors. Vegetation is assessed using NDVI derived from Sentinel-2 or Landsat imagery:

$$\mathbf{NDVI = (NIR - Red) / (NIR + Red).}$$

Higher NDVI indicates better vegetation conditions and greater potential for nature-based tourism [5]. Water bodies increase recreational attractiveness, while their ecological quality should also be considered. Landscape naturalness and LULC are important for ecotourism, whereas protected areas require consideration of ecological sensitivity and visitor capacity [6]. Anthropogenic pressure from population, roads, construction, industry, and waste reduces tourism potential and should be included as a separate spatial criterion [7].

GIS-Based Cartographic Modeling. All datasets are transformed into a common coordinate system, checked for accuracy, and standardized to a common raster scale. The indicators are reclassified and weighted according to their importance. The final map can classify tourism potential into very high, high, moderate, low, and very low levels.

Sensitivity analysis is used to test the stability of the model, while field observations, tourist sites, and expert assessments can support validation [8].

Results and Discussion. The proposed model provides an integrated assessment of environmental tourism potential and its spatial distribution. GIS-MCDA and AHP support the identification and zoning of environmentally suitable tourism areas.

The methodology is particularly applicable to the mountainous and foothill areas of Tashkent Region, where diverse landscapes, forests, water resources, elevation zones, and tourist attractions create different conditions for ecotourism. However, high tourism attractiveness should be assessed together with ecological carrying capacity and recreational pressure [9].

Nighttime-light data can additionally indicate anthropogenic activity and tourism infrastructure dynamics. Combining environmental suitability with tourism activity makes it possible to identify areas with high tourism development and ecological sensitivity. Based on the assessment, territories can be divided into three management categories: **(1)** high environmental potential and low pressure—controlled ecotourism development; **(2)** high attractiveness and high pressure—recreational-load management; and **(3)** high ecological sensitivity or degradation—protection and restoration.

Conclusion. The proposed GIS-based methodology integrates vegetation, water resources, landscape naturalness, protected areas, anthropogenic pressure, relief, and degradation to assess tourism potential. Remote sensing, GIS-MCDA, and AHP enable indicators to be standardized, weighted, and combined into an integrated index.

The methodology provides a basis for identifying suitable tourist areas, spatial zoning, and regulating recreational pressure. Its application in the mountainous areas of Tashkent Region can support scientifically grounded and sustainable tourism planning.

References:

1. Omarzadeh, D., Pourmoradian, S., Feizizadeh, B., Khallaghi, H., Sharifi, A., & Valizadeh Kamran, K. (2022). A GIS-based multiple ecotourism sustainability assessment of West Azerbaijan province, Iran. Journal of Environmental Planning and Management, 65(3), 490–513. DOI: 10.1080/09640568.2021.1887827.

2. Kaymaz, Ç. K., Çakır, Ç., Birinci, S., & Kızılkan, Y. (2021). GIS-Fuzzy DEMATEL MCDA model in the evaluation of the areas for ecotourism

development: A case study of Uzundere, Erzurum-Turkey. Applied Geography, 136, 102577. DOI: 10.1016/j.apgeog.2021.102577.

3. Shahzada, M. I., et al. (2022). Ecotourism potential assessment for Gilgit-Baltistan, Pakistan using integration of GIS, remote sensing, AHP and crowd-sourced data. Geocarto International, 37(25), 8724–8745. DOI: 10.1080/10106049.2021.2005157.

4. Yasin, K. H., & Woldemariam, G. W. (2023). GIS-based ecotourism potentiality mapping in the East Hararghe Zone, Ethiopia. Heliyon, 9. DOI: 10.1016/j.heliyon.2023.e18567.

5. Geospatial Analysis of Geo-Ecotourism Site Suitability Using AHP and GIS for Sustainable and Resilient Tourism Planning in West Bengal, India. (2022). Sustainability, 14(4), 2422. DOI: 10.3390/su14042422.

6. Application of AHP and geospatial technologies to assess ecotourism suitability: A case study of Saint Martin's Island in Bangladesh. (2023/2024). Journal of Sea Research.

7. Nigmatov, A., Rasulov, A., & Tobirov, O. (2022). Methodology for Assessing the Tourist Potential of the Nature of the Fergana Valley Using GIS Technologies and Experimental Methods. Journal of Pharmaceutical Negative Results, 13(Special Issue 08), 2268–2286. DOI: 10.47750/pnr.2022.13.S08.281.

8. An ecotourism suitability index for a world heritage city using GIS-multi criteria decision analysis techniques. (2024). Heliyon. DOI: 10.1016/j.heliyon.2024.e34330.

9. Mankelkelot, T. K., Ayele, N. A., Jothimani, M., & Tenzer, R. (2026). Integrating GIS and AHP for sustainable ecotourism site suitability analysis: A case study of Bahir Dar, Ethiopia.