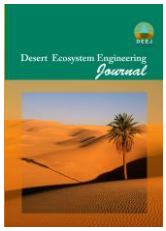
DEEJ (2026) 14 (4) 1-2

University of Kashan

Desert Ecosystem Engineering Journal

Journal homepage: http://deej.kashanu.ac.ir



A Land Use Planning Analysis of Ecotourism-Suitable Zones Based on Sand Spa in The Eastern Isfahan Province

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Received: 16/12/2025 Accepted: 29/01/2026

Introduction

Ecotourism is a form of tourism founded on principles of environmental respect and conservation. Its primary objective is to enable responsible engagement with natural areas, minimizing ecological harm while often contributing to preservation and restoration efforts. A core dimension of ecotourism involves travel to natural settings for health and wellness purposes. Health tourism, in this context, encompasses any travel undertaken to enhance personal well-being, specifically emphasizing the therapeutic and restorative utilization of natural environments. This approach is inherently aligned with the goals of ecological and economic sustainability. In the contemporary era, the pressures and adverse effects associated with modern lifestyles have intensified the need to integrate health-focused activities within natural settings. Consequently, health-oriented tourism segments are expanding more rapidly than many other sectors of the global tourism industry. Both governmental bodies and private institutions are increasingly prioritizing the development of health tourism as a distinct market segment and a valuable supplement to public health services. Effective management and development of health tourism must begin with a comprehensive assessment of a region's inherent capabilities, constraints, strengths, and unique attractions. Spatial planning provides a critical foundation for this process by identifying and allocating suitable land uses, thereby facilitating the optimal and sustainable utilization of natural and cultural resources. Unplanned or excessive use of natural areas, without due regard for their ecological carrying capacity, inevitably leads to environmental degradation, inefficient capital investment, and ultimately, unsustainable development. Therefore, this research represents a step toward systematic land-use planning for areas suitable for nature-based tourism, with a specific focus on health tourism. Its central aim is to identify and leverage natural assets—particularly the potential of sand therapy spas—to inform sustainable development strategies.

Methodology

This study adopts an applied research design, employing a mixed-methods approach that integrates library research, field surveys, and spatial data analysis within the ArcGIS and Google Earth environments. The methodological procedure was structured into six sequential stages: Through a review of analogous studies focused on nature-based tourism and spatial analysis, the key criteria and indicators relevant to developing sand therapy spas were identified. This foundational step is essential, as the transformation of sandy areas into therapeutic sites requires systematic identification, interpretation, preservation planning, and the design of tailored tourism programs and services. The geographical locations of relevant features were determined and catalogued. This included natural attractions, existing tourism facilities, service centers, potential hazard zones, and distinctive landscape elements. Digital spatial layers were generated for each influencing sub-criterion, categorized as either *distance* or *density* layers. Density layers were calculated and mapped based on the frequency of point phenomena or the length of linear phenomena per unit area. Distance layers were derived using Euclidean distance analysis from specified source features. Given that the various input layers possess different measurement units and scales, their integration required standardization onto a uniform, dimensionless scale. Each sub-criterion layer was normalized according to its specific influence within the analytical model, with resulting values ranging from 0 to 1. In this framework, a value closer to 1 indicates a higher level of desirability or suitability. Composite criteria layers were synthesized from their normalized sub-criteria components using a weighted linear combination (mathematical averaging) method. The subsequent integration of these criteria layers produced the final composite map, identifying areas susceptible or suitable for sand therapy spa development.

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DOI: 10.22052/deej.2026.257983.1127

The final composite suitability layer was classified into five distinct zones—from "Very Suitable" to "Very Unsuitable." This classification was informed by an analysis of natural constraints (*natural breaks*) and validated through a comparison of means test. The resultant zoning map delineates the territorial suitability for establishing sand therapy sites within the study region.

Results and discussion

The integration of digital indicator layers produced composite maps for each influential criterion. In these layers, higher normalized values (approaching 1) indicate greater desirability for sand therapy spa development. Analysis reveals that the maximum value for the accessibility criterion (0.984) is located in the western part of the region. Similarly, the highest values for tourism service centers (0.927) and tourist attraction centers (0.754) are concentrated in the western and northwestern sectors. For the hazard criterion—where a higher value denotes lower risk—the maximum (0.859) is found in the northern, northwestern, and northeastern zones. Through the weighted synthesis of all criteria layers, a final composite suitability map was generated and classified into five land suitability categories. The "Very Suitable" zone, encompassing 2,250.47 square kilometers, predominates in the western and northwestern regions, constituting approximately 98.2% of the total study area. The "Suitable" class covers 761.96 square kilometers (roughly 74.12% of its referenced sub-region) and is primarily found in the northeastern, southern, and western areas. The "Average" suitability zone spans 135.22 square kilometers (about 64.28% of its sub-region), located in the northwestern and western parts. Conversely, the "Unsuitable" class, covering 904.25 square kilometers (approximately 79.32% of its sub-region), is mainly distributed in the eastern sectors. Finally, the "Very Unsuitable" zone occupies 648.17 square kilometers (around 83.22% of its sub-region), concentrated in the northern and southeastern regions.

The results indicate a clear spatial polarization in suitability. The western and northwestern regions emerge as optimal due to their superior accessibility, concentration of tourism services and attractions, and relatively lower hazard levels. This combination designates them as priority areas for strategic development of sand therapy spas. In contrast, the eastern, northern, and southeastern zones, classified as unsuitable or very unsuitable, are limited by poorer infrastructure, accessibility, and/or higher hazard potential. Development in these areas is not recommended without significant prior investment to address these constraints. The extensive area classified as "Very Suitable" (98.2% of the total region) highlights the substantial inherent potential of eastern Isfahan province for sand therapy tourism. However, this finding requires careful interpretation. While indicating high overall capacity, it must be balanced with considerations of ecological carrying capacity and on-the-ground realities to ensure that development is sustainable and avoids environmental degradation or resource overuse.

Conclusion

The results indicate that areas most suitable for sand therapy spa development are predominantly located within the Maranjab, Khara, Zavareh, Mesr, and Khoor deserts. This spatial pattern is attributed to these zones' favorable accessibility, presence of tourism service centers and attractions, and relatively lower environmental and anthropogenic risks. The classification of these areas as highly suitable is directly linked to the optimal confluence of key indicators, including expansive sandy terrains, established road networks, accommodation facilities, restaurants, and proximity to medical services. Furthermore, the analysis identifies zones with moderate suitability in the northern, central, and eastern parts of the study area. However, these regions currently lack targeted development initiatives. Their potential remains untapped, necessitating deliberate and comprehensive planning to equip them with the essential infrastructure required for sand therapy tourism and to facilitate their integration into the nature tourism circuit. Despite possessing significant sandy landscapes with high potential for nature-based health tourism, eastern Isfahan province remains largely unrecognized as a destination beyond local communities and niche ecotourism enthusiasts. A critical gap exists between the region's inherent potential and its current state of development; essential, specialized facilities for sand spa operations are notably absent, even in areas with a strong foundational potential.

Consequently, the output of this study—a detailed spatial suitability map—serves a dual purpose. Primarily, it provides a strategic guide for nature and health tourists, as well as tour operators, to identify viable locations. Secondly, and more significantly, it offers a scientific and evidence-based document for regional managers and policymakers. This document can inform constructive decision-making and guide the implementation of sustainable development strategies to responsibly harness this unique ecotourism potential.

Keywords: Sand Fields, Landuse planning, Spatial analyses, Ecotourism, Sand therapy, Isfahan province.