

Georesource Potential Evaluation for Sustainable Balneotourism by AHP - A Case Study of Veľaty

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Abstract

The paper examines the development potential of Veľaty, historically recognized as a former spa site, in the context of tourism, with particular emphasis on the use of the Slaná studňa mineral spring. To ensure a systematic and objective evaluation, the Analytic Hierarchy Process (AHP) was employed as a multicriteria decision-making tool. Based on expert assessment, we assigned weights to nine criteria covering the area's natural, infrastructural, and safety dimensions. The resulting weighted attractiveness score reached 2.83 out of 5.00, indicating a moderate level of development while simultaneously revealing considerable untapped potential. The analysis identified site safety, the therapeutic value of the mineral spring, and accessibility as the principal determinants of development. Conversely, significant deficiencies were observed in the limited quality of services, underdeveloped infrastructure, and inadequate utilization of the mineral spring's potential. In response to these disparities, a set of targeted measures is proposed, focusing on environmental revitalization, certification of the mineral resource, and integrating the locality into the Zemplín Geopark's tourism product portfolio. Implementing these measures provides a strategic pathway to transform the site from an isolated attraction into a comprehensive regional tourism product with substantial added value.

Keywords

tourism; balneotourism; Analytic Hierarchy Process (AHP); mineral spring; site attractiveness; regional development



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Introduction

Tourism is one of the fastest-growing sectors of the global economy, playing a key role in regional development and the economic diversification of territories. Over the past six decades, it has expanded and diversified, becoming one of the largest economic sectors and contributing approximately 10% to global gross domestic product (UNWTO, 2016; Hanvoravongchai & Paweenawat, 2025). In recent years, driven by ongoing social changes and the growing prevalence of high-stress lifestyles, demand for leisure and recreational activities has increased as an alternative approach to addressing physical and mental health conditions (Chrobak et al., 2020). This trend is closely associated with the rise of slower, more sustainable forms of tourism that emphasize a deeper connection with nature, including practices such as forest therapy, the benefits of favorable climatic conditions, and the utilization of mineral water resources for health and well-being purposes (Buckley and Cooper, 2022; AVECILLAS-TORRES et al., 2025). Goeldner and Ritchie (2012) define tourism as a complex system dependent on the interaction of natural resources, infrastructure, destination management, and marketing. In this context, Buhalis (2000) emphasizes that future destination competitiveness depends on strategic management and purposeful marketing that can transform natural potential into a sustainable economic product with added value for both visitors and the local community.

While many destinations focus on product diversification, balneotourism destinations are increasingly regarded as primary providers of health and well-being services (B. Chen et al., 2023; Bozhkova, 2025). This segment, encompassing spa, wellness, and balneology, attracts thousands of domestic and international visitors annually (Yen et al., 2018). The hot springs sector alone generates approximately two million jobs each year, with a global output value of around USD 200 billion (Medai et al., 2022). Developing these resources plays a crucial role in increasing employment, improving income levels, and fostering regional economic prosperity (Hou & Huang, 2010). However, Hall (2011) highlights that health and medical tourism represents a double-edged sword for global public health: on the one hand, it stimulates the development of healthcare infrastructure and access to therapeutic resources; on the other, uncontrolled growth may lead to systemic inequalities and regulatory risks. Smith and Puczek (2014) expand this perspective by proposing a comprehensive framework linking health, hospitality, and tourism, emphasizing the need for a holistic and interdisciplinary approach to developing health tourism destinations.

Slovakia, with its high concentration of mineral water resources, possesses considerable potential in this regard. However, in localities such as Veľatý, this potential remains largely latent. Balneotourism has evolved beyond traditional balneology into a complex economic sector. The successful transformation of a locality into an attractive destination depends on identifying and managing so-called *Critical Success Factors*.

A fundamental pillar of attractiveness lies in the physical-chemical properties of the natural resource. As noted by Tirinsi et al. (2024), the suitability of springs for therapeutic purposes is directly determined by water quality stability, temperature, and specific mineral composition. According to Erfurt-Cooper (2010), such resources can be classified as geothermal (therapeutic), mineral (drinking and bathing), brine (suitable for dermatological and musculoskeletal conditions), or extremely hot springs. Mineralization and temperature (exceeding the average ambient temperature by more than 4 °C) define their therapeutic value (Anaya-Aguilar et al., 2021). Furthermore, Madani et al. (2026) emphasize that achieving destination competitiveness requires synergy between supporting services, community involvement, and modern „smart“ destination management.

Secondary infrastructure and service quality are equally important. Current trends indicate that spa facilities represent a dominant source of revenue for resorts, while contemporary visitors increasingly seek unique experiences and high-quality gastronomy (Anaya-Aguilar et al., 2021). Research also confirms that price, staff quality, and the level of privacy are key factors influencing destination choice (Kucukusta and Guillet, 2014). Madanoglu and Brezina (2008) showed that efficiently managed spa operations can account for more than 20% of resort accommodation revenues. The area's historical and cultural dimension is also significant. Mineral springs represent not only natural resources but also key elements of cultural heritage and regional identity (Lee & King, 2010). The tradition of their use enhances a destination's authenticity and can significantly increase its attractiveness. San José Arango (2016), in his study on spa and therapeutic hotels (curhoteles), demonstrates that integrating historical healing traditions with modern hospitality services represents a key strategy for increasing competitiveness in health tourism facilities. Thus, spa heritage functions not only as a cultural legacy but also as an active marketing asset.

Finally, technical and organizational factors – particularly safety and accessibility – play a crucial role. As Tirinsi et al. (2024) note, accessibility is one of the key determinants of the actual use of natural resources in tourism. In the international context, an illustrative example of balneotourism resource planning is provided by a case study of the Tangshan resort in Nanjing, China. Shule Cao (2025) highlights that traditional tourism development models, overdevelopment, and product homogenization can significantly limit the potential of such destinations. The author emphasizes the necessity of a comprehensive analysis of natural and cultural conditions as a prerequisite for effective tourism planning. These findings are directly relevant to the case of Veľatý, where

similar barriers – insufficient product differentiation and the absence of systematic management – hinder the full utilization of existing natural potential.

Assessing the potential of such areas is a complex process constrained by the limitations of traditional approaches. As Nuriyev (2022) notes, incomplete data and high uncertainty often complicate site selection. Consequently, contemporary research increasingly integrates advanced multicriteria decision-making (MCDM) models. Mardani et al. (2016), in a systematic review of MCDM applications in tourism and hospitality, document their wide-ranging use – from site selection and destination evaluation to the optimization of accommodation management.

While earlier studies focused on resource management and visitor satisfaction (Liu et al., 2019), more recent hybrid models (e.g., FUCOM, Fuzzy MARCOS) enable more advanced benchmarking (Mijajlović et al., 2020). Recent trends (as of 2025) combine Fuzzy with Grey Relational TOPSIS to quantify sustainable development more precisely (Yang et al., 2025).

One of the most widely recognized global methods for site selection and evaluation remains the Analytic Hierarchy Process (AHP) (Saaty, 1980; Yap et al., 2019). This method decomposes complex systems into hierarchical levels and helps identify imbalances between natural resources and infrastructure (Popovic et al., 2019). Abed et al. (2011) demonstrated its practical application by developing a comprehensive site selection methodology for sustainable coastal tourism in Guilan Province, Iran. By integrating GIS-based spatial analysis, Boolean logic, and the AHP method, the authors evaluated seventeen candidate destinations across thirty criteria covering environmental, transport, and demand-related aspects. The resulting hierarchical classification confirmed that such an integrated approach enables objective and transparent ranking of competing destinations, which is directly relevant to the methodology applied in the present study.

Bunruamkaew and Murayama (2011) adopted a similar approach, combining GIS and AHP to assess ecotourism suitability in Surat Thani Province, Thailand, showing that spatial multicriteria analysis effectively identifies areas with the highest development potential while respecting environmental constraints. Furthermore, according to Judit et al. (2025), the integration of traditional methods with artificial intelligence (AI) tools represents an effective pathway to enhance the competitiveness of smaller destinations.

The aim of this paper is to evaluate the tourism potential development of the Veľatý site using the AHP method, with particular emphasis on the use of the Slaná studňa mineral spring. To achieve this objective, we determined weights for nine criteria based on expert evaluation, identified the area's key strengths and weaknesses, and formulated recommendations to support more effective use of the locality's potential within the framework of regional development.

Materials and Methods

The main scientific problem addressed in this study is the quantification and objective evaluation of the development potential of the Veľatý area, which possesses a unique natural resource (Slaná studňa mineral spring). The research object is the recreational and balneological potential of the municipality of Veľatý. The research subject consists of factors (criteria) that influence the locality's attractiveness from the perspective of experts and visitors. For the multicriteria analysis, nine key criteria were defined based on a literature review (Tirinsi et al., 2024; Anaya-Aguilar et al., 2021; Mi et al., 2019) and local specificities. These criteria are grouped into three functional areas (Tab. 1).

<i>Table 1 Definition and categorization of evaluation criteria</i>			
Area	Code	Criterion	Brief description
Natural potential	C1	Chemical composition	Content of mineral substances and the unique chemical characteristics of the water
	C2	Therapeutic effects	Demonstrable impact on health (indications of the spring)
	C3	Physical properties	Water temperature, spring yield, and organoleptic properties
Infrastructure and services	C4	Availability of accommodation	Capacity and quality of accommodation services within the locality
	C5	Availability of catering	Network of dining facilities and quality of gastronomic services
	C6	Natural (complementary) attraction	Natural and cultural attractions in the surrounding area (Zemplín Geopark).
Organizational and safety aspects	C7	Spa tradition	Historical awareness of the locality and its "genius loci".
	C8	Site safety	Physical safety, hygiene, and technical condition of the area
	C9	Transport accessibility	Connectivity to the road network, parking, and signage

To achieve the main objective (evaluation of the locality's potential and proposal of development measures), the following research questions (RQ) were formulated:

- RQ 1: Which factors (natural, infrastructural, or safety-related) are considered by experts to be the most important in influencing visitors' decisions when selecting a balneo or recreational destination?

- RQ 2: What is the level of correlation (consistency) between the high natural potential of the spring (C1, C2, C3) and the current state of supporting services (C4, C5) in the area?
- RQ 3: Is there sufficient synergy in the locality between the historical spa (balneo) tradition (C7) and modern requirements for safety (C8) and visitor comfort?

To address the research problem, a methodology based on multicriteria decision-making was adopted. The research process is structured into the following logical phases:

1. Analytical phase: Identification of nine relevant criteria (C1- C9) based on a literature review and local specific conditions.
2. Expert phase: Application of the Analytic Hierarchy Process (AHP) to determine the weights of criteria through pairwise comparison. This phase transforms subjective expert judgments into precise mathematical weights.
3. Evaluation phase: Quantitative assessment of the degree to which each criterion is fulfilled in the Veľaty locality using a scale from 1 to 5, followed by the calculation of the overall weighted attractiveness score.
4. Synthesis phase: Identification of critical issues (weaknesses) and formulation of strategic recommendations for regional development.

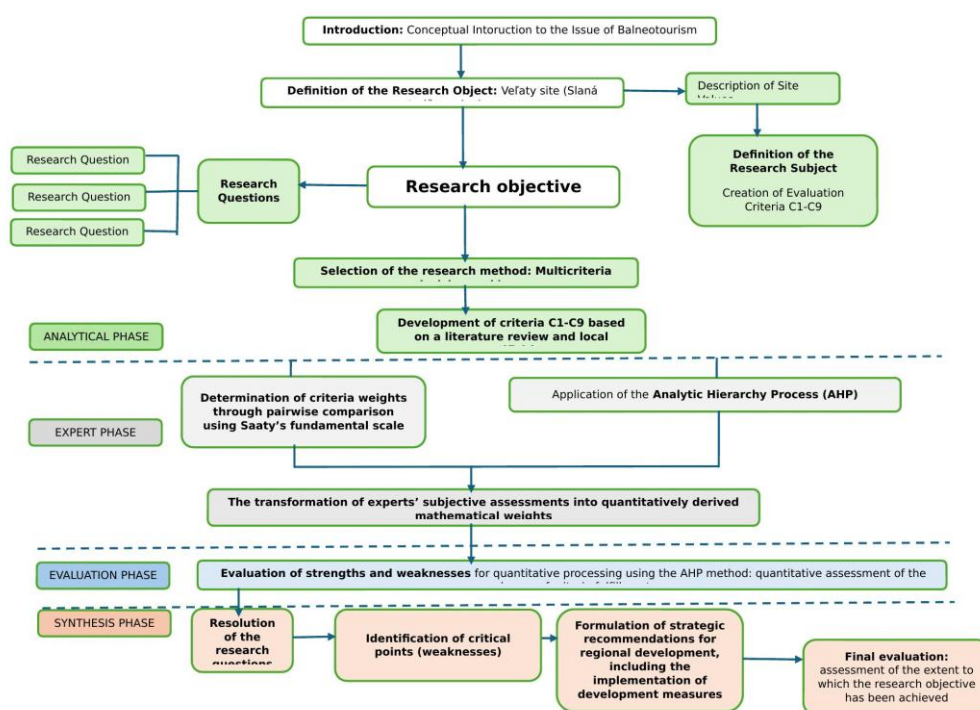


Fig.1 Design of research methodology

The methodological approach combines qualitative research (expert field survey and historical analysis) with quantitative processing (the AHP mathematical model and consistency indices), ensuring a high level of validity and reliability of the obtained results.

Characteristics and Regional Context of the Locality

The study area is located within the cadastral territory of the municipality of Veľaty, situated in the southeastern part of the Slovak Republic (NUTS II region – Eastern Slovakia). Administratively, the municipality belongs to the Košice Region and the Trebišov District.

Geographically, the municipality lies at the interface between the East Slovak Lowland and the foothills of the Zemplín Mountains, within the historical region of Lower Zemplín, approximately 14 km south of the district town of Trebišov. The approximate geographic coordinates of the locality's center are 48°31' N latitude and 21°40' E longitude. The broader spatial positioning of the municipality within Slovakia is illustrated in Fig. 2

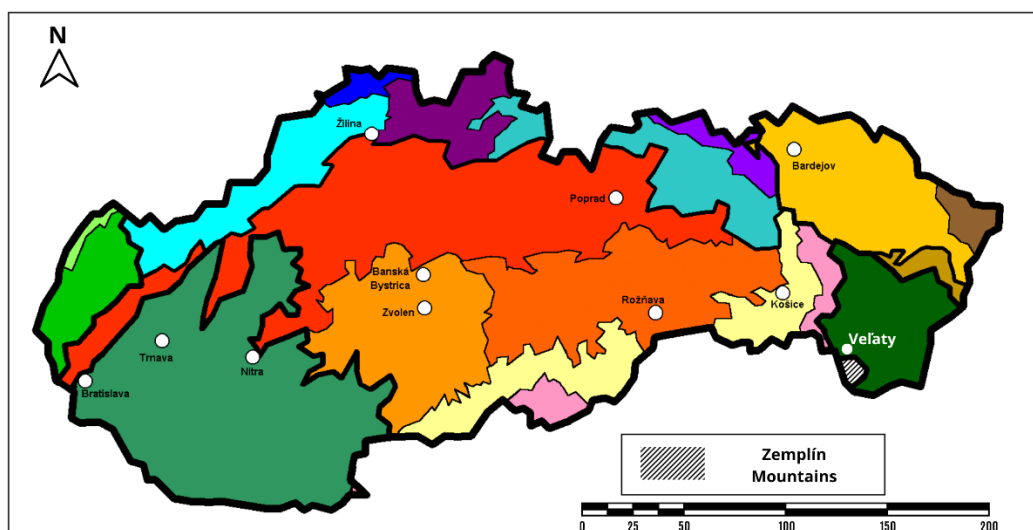


Fig.2 Geographical location of the municipality of Veľatý within the Slovak Republic

From a tourism perspective, the locality constitutes an integral part of the Zemplín Geopark, with the core of this area formed by the aforementioned Zemplín Mountains (Fig. 3).

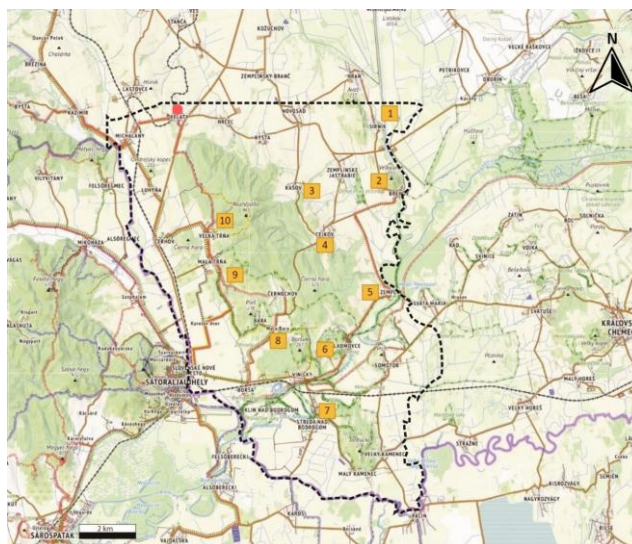


Fig.3 Geographical location of the municipality of Veľatý (marked with a red dot) in relation to the Zemplín Geopark (The dashed line represents the geopark boundary, and the numbered points indicate its current geosites: 1 – Sirník, 2 – Brehov, 3 – Kašov, 4 – Cejkov, 5 – Zemplín, 6 – Ladmovce, 7 – Streda nad Bodrogom, 8 – Malá Bara, 9 – Malá Trňa, 10 – Veľká Trňa [Babicová et al, 2026])

The Zemplín Geopark provides a fundamental institutional and natural framework for advancing geotourism in the region. It covers approximately 332 km² and encompasses 30 municipalities. Its significance stems from its exceptionally diverse geological structure, which has shaped the landscape since the Paleozoic era.

Throughout geological history, from the Paleozoic to the present, a range of geological processes has shaped the area's current morphology. The most prominent geomorphological unit is represented by the Zemplín Mountains, a moderately dissected mountain range rising above the East Slovak Basin, with its highest elevation at Rozhl'adňa (469 m a.s.l.). From a structural perspective, the Zemplín Mountains form a horst uplift bounded by faults trending in a north-southeast direction. The area's geological complexity is evident in lithologically and stratigraphically diverse rock units representing multiple geological periods. (Štrba et al, 2015; Rybárová et al., 2024)

The geological composition includes formations ranging from the Late Paleozoic to the Mesozoic, such as sandstones, conglomerates, clayey shales, limestones, and dolomites. Indicators of paleoenvironmental changes, including transitions from humid to arid climatic conditions, are preserved within the sedimentary record. Volcanic activity has also contributed to the region's geological heterogeneity, with rhyodacitic and andesitic rocks occurring predominantly along the mountain range's margins. (Molokáč et al. 2023a; Molokáč et al. 2023b).

Key characteristics of the Zemplín Geopark:

- Site diversity: The geopark comprises 54 registered localities, including 13 geological sites, 7 natural sites, 17 geo-mining sites associated with historical mining activities, 4 wine-related sites, 11 historical-cultural sites, 1 historical site, and 1 archaeological site. (Molokáč et al. 2023b).
- Natural potential: The area is characterized by the presence of highly mineralized springs and well-preserved ecosystems, which provide favorable conditions for the development of environmental tourism.
- Cultural context: The geopark integrates its natural attributes with the Tokaj viticultural tradition and the region's cultural and historical heritage.

The region is characterized by the historical presence of spa facilities, which no longer exist today, with only the mineral springs or dilapidated buildings remaining as evidence of their former function. Historically significant localities such as Byšta (focused on rheumatic diseases) and Veľaty (associated with respiratory conditions) no longer hold the status of spa destinations, and their potential is presently limited to seasonal recreation and individual tourism. This discontinuity in the use of natural therapeutic resources is a key barrier to regional development, which this study examines. Including the municipality of Veľaty within the Zemplín Geopark structure creates the preconditions to transform the area into an inclusive destination suitable for both education and recreation. Despite this supra-regional potential, the site shows signs of infrastructural stagnation and low effective use of its existing resources. This discrepancy between the area's natural and historical value and its current material condition makes Veľaty a relevant subject for multicriteria evaluation using the AHP method. The analysis aims to identify the barriers preventing the locality's transition from a latent stage to a competitive position within the regional tourism landscape.

Evaluation Methods

Basic statistical and mathematical methods were applied to process the collected data, enabling quantification of the significance of individual criteria and subsequent evaluation of the studied locality. The key method used in this research was the multicriteria decision-making method AHP (Analytic Hierarchy Process), which determines the relative weights of criteria based on pairwise comparisons.

The AHP method is based on pairwise comparison, in which preference relationships between pairs of criteria are established. Each criterion is compared with others according to its relative importance. The pairwise comparison uses Saaty's fundamental scale, which quantifies the degree of preference of one criterion over another (Tab. 2).

Table 2 Saaty's fundamental scale

Score	Explanation
1	Criteria are equally important
3	One criterion is slightly more important than the other.
5	One criterion is significantly more important than the other.
7	One criterion is demonstrably more important than the other.
9	One criterion is absolutely more important than the other.

Intermediate values (2, 4, 6, 8) can be used for finer distinctions in the degree of preference between criteria. Based on pairwise comparisons, a Saaty matrix is constructed, from which the weights of individual criteria are subsequently calculated. The weights are determined using the eigenvalues and corresponding eigenvectors of this matrix.

A prerequisite for correct decision-making is adherence to the consistency rule when assigning importance to individual criteria. If the consistency condition is not satisfied, the evaluator should reconsider the assigned values. Consistency analysis is performed using the consistency index (*CI*) and the consistency ratio (*CR*), defined as:

$$CI = \frac{\lambda_{max} - n}{n - 1}, \quad CR = \frac{CI}{RI}, \quad (1)$$

where λ_{max} is the maximum eigenvalue of the Saaty matrix, n is the number of criteria, and *RI* (RandomIndex) is the average consistency index, which for $n = 9$ equals 1,45. The matrix is considered sufficiently consistent if $CI < 0,1$ or $CR < 0,1$. If this condition is not met, it is necessary to revise the input values and adjust the pairwise comparisons to ensure a higher level of consistency in decision-making.

Results and Discussion

The evaluation of the development potential of the Veľatý site was carried out in three consecutive phases, enabling a systematic transition from theoretical foundations to practical recommendations:

1. Expert weighting of criteria: Using pairwise comparison, we assigned weights to nine key criteria, enabling an objective assessment of the importance of natural, infrastructural, and safety factors in shaping destination attractiveness.
2. Diagnosis of the current state: Based on the calculated weights, both quantitative and qualitative analyses of the site were conducted, precisely identifying strengths (unique chemical composition of the spring, location within the Zemplín Geopark) and weaknesses (stagnant infrastructure, absence of services).
3. Strategic development proposal: The synthesis of results led to the formulation of targeted measures aimed at more effective utilization of the existing potential within the framework of regional development and economic diversification of southeastern Slovakia.

The following subsections present the outputs of each of these phases in detail.

Determination of Criteria Weights Using the AHP Method

A pilot study involved 12 experts from the field of tourism, spa management, hydrogeology, and regional development. Using a questionnaire, they conducted pairwise comparisons of nine key criteria (C1 - C9), identified as decisive factors influencing the site's attractiveness. The degree of preference was determined using Saaty's fundamental scale (1, 3, 5, 7, 9), expressing the relative importance of pairs of criteria. Based on the completed comparison matrices, the resulting criterion weights were calculated using the matrix's eigenvalues and eigenvectors.

List of evaluated criteria:

- Natural potential: chemical composition (C1), therapeutic effects (C2), physical properties (C3).
- Infrastructure and services: accommodation (C4), catering (C5), natural attractions (C6).
- Context and safety: spa tradition (C7), safety (C8), accessibility (C9).

The resulting Saaty pairwise comparison matrix for the first expert (Expert 1) is presented in Tab.3. The evaluation by Expert 1 indicates that the most significant criterion is site safety (C8), followed by the therapeutic effects of the spring (C2) and the proximity of natural attractions (C6).

Table 3 Saaty pairwise comparison matrix and weights of factors (Expert 1)

	C1	C2	C3	C4	C5	C6	C7	C8	C9	Weight (%)	Rank
C1	1	1/3	1	1/3	1/3	1/5	1	1/5	1/3	9.12	7
C2	3	1	3	3	3	1	3	1/3	1	12.87	2
C3	1	1/3	1	1/3	1/3	1/5	1	1/5	1/3	8.05	8
C4	3	1/3	3	1	1	1/3	3	1/5	1	10.94	5
C5	3	1/3	3	1	1	1/3	1	1/5	1	10.08	6
C6	5	1	5	3	3	1	3	1/3	1	12.10	3
C7	1	1/3	1	1/3	1	1/3	1	1/7	1/3	7.97	9
C8	5	3	5	5	5	3	7	1	3	16.93	1
C9	3	1	3	1	1	1	3	1/3	1	11.94	4

The consistency of the evaluation was verified using the consistency index ($CI=0,049$) and the consistency ratio ($CR=0,034$). Since the CR did not exceed the 0.10 threshold, the matrix is considered consistent. The same procedure was applied to determine the criteria weights for the remaining experts.

Only those evaluators whose Saaty matrices met the condition of sufficient consistency ($CR < 0.10$) were included in further analysis. The final average weights were calculated based on the results of six experts who met the consistency requirement. Table 4 presents the resulting average weights for the individual criteria.

Table 4 Final average weights of the evaluated criteria (in %)

Weights	Evaluated criteria								
	C1	C2	C3	C4	C5	C6	C7	C8	C9
Average [%]	9.12	12.87	8.05	10.94	10.08	12.1	7.96	16.93	11.94
Rank	7.	2.	8.	5.	6.	4.	9.	1.	3.

The average values indicate that site safety (16.93 %), therapeutic effects (12.87 %), and accessibility (11.94 %) are the most important. In contrast, experts assigned the lowest priority to spa tradition (C7) and the physical-chemical properties of the spring (C1,C3). The overall ranking of the criteria is as follows: $C8 > C2 > C9 > C6 > C4 > C5 > C1 > C3 > C7$, i.e., site safety > therapeutic effects of the spring > accessibility > proximity of natural attractions > proximity of accommodation facilities > proximity of catering facilities > chemical composition of

the spring > physical properties of the spring > spa tradition of the locality. The results suggest that, from the visitor's perspective, key determinants are safety, functional potential, and accessibility, while historical context and the water's technical parameters are perceived as secondary factors. Although the AHP method is based on subjective expert judgment, adherence to eigenvalue and eigenvector calculations ensures sufficient objectivity for subsequent multicriteria evaluation of the locality.

Evaluation of the Veľaty Site

After determining the criteria weights (C1 - C9), a detailed analysis of the Veľaty site was conducted. The assessment was based on field research, available hydrogeological documentation, and historical sources. This section compares the identified potential with the actual conditions in the area and identifies key barriers to developing balneological and recreational activities.

Characteristics of the Site and the Development of Spring Utilization

The area's dominant feature is the mineral spring known as Slaná studňa, a significant natural resource with potential for recreational use and balneological promotion. The spring is located on the southwestern edge of the municipality of Veľaty, approximately 100 meters southeast of the railway line (Fig.4).



Fig.4 Mineral water spring Slaná studňa, Veľaty [municipality]

The spring was structurally modified and lined with masonry in 1890, although the local population had known of it since the 18th century. Historical sources also refer to it as Aqua Velejtenis, a name used by the natural scientist Paul Kitaibel. The spring area was originally located on private land owned by noble families and was later acquired by the Andrassy family. At the end of the 19th century, spa facilities were established near the spring, primarily for treating upper respiratory diseases and thyroid disorders. After a decline during the interwar period and the site's devastation after World War II (when the area was used for ammunition disposal), a major revitalization took place between 2014 and 2016. The municipality of Veľaty initiated spring cleaning, reinforced the stone structure, and built basic recreational infrastructure (shelter, wooden platform, access pathway). From a hydrogeological perspective, the spring is classified as a natural, moderately mineralized chloride-hydrogen carbonate type with a sodium character and a specific content of boric acid. Key parameters according to Tometzová (2018) are summarized as follows:

- Water temperature: approximately 12 °C (cold spring),
- Total dissolved solids: 13,994 mg/l,
- Sodium (Na⁺): 2,402 mg/l,
- Chlorides (Cl⁻): 2,580 mg/l,
- Yield: approximately 10 l/min.

The water is visually clear, odorless, and has a distinctly salty taste. Despite technical improvements and its evident therapeutic properties, the current condition of the locality in terms of management and systematic maintenance remains insufficient. The surrounding area is affected by secondary vegetation and fragmented infrastructure, which reduces overall visitor comfort.

It can be concluded that while the natural and historical potential (represented by criteria C1, C2, and C7) is high, the infrastructural response and service quality (C4, C5, C8) constitute the main barrier to transforming the site into a competitive destination of regional significance.

Evaluation of the Veľatý Site According to Defined Criteria

Individual criteria (C1 - C9) were assessed based on field research, secondary data analysis, and available information on the natural, historical, and infrastructural characteristics of the municipality of Veľatý. This assessment aimed to determine the extent to which the development potential is fulfilled and to identify key barriers to growth.

- Chemical composition of the spring (C1): The Slaná studňa mineral spring is characterized by a distinct salty taste, indicating high mineralization. Although historically classified as a saline alkaline iodine water with beneficial effects on the human body, the absence of current certified analyses limits its precise validation for modern balneological applications.
- Therapeutic effects of the spring (C2): The healing potential is supported by a long history of spa use (respiratory diseases, thyroid disorders). However, the lack of systematic contemporary medical verification reduces its market value within modern balneotourism.
- Physical properties of the spring (C3): The water is highly clear, odorless, and exhibits stable sensory properties. Despite its suitability for recreational use, continuous monitoring of yield and chemical stability is lacking, which is essential for investment planning.
- Availability of accommodation and catering facilities (C4, C5): There are no significant capacities in the immediate vicinity of the spring. Dependence on the wider region and the limited availability of basic services directly at the site reduce visitor comfort and shorten the average length of stay.
- Proximity of natural attractions (C6): Inclusion in the Zemplín Geopark is the most significant development driver. The high landscape value and concentration of natural features in the surrounding area create ideal conditions for geotourism.
- Spa tradition of the site (C7): The historical spa legacy represents an important cultural asset. However, this tradition is currently neither sufficiently visualized nor effectively promoted, weakening local identity.
- Site safety (C8): The calm rural environment positively affects visitors. However, limiting factors include neglected vegetation around the spring, lack of regular maintenance, and risks associated with the proximity of the railway without adequate safety barriers.
- Accessibility of the site (C9): From a regional perspective, the municipality is well accessible. However, the local navigation system and the quality of the access path to the spring are inadequate, negatively affecting orientation and overall inclusiveness.

Based on the findings, Tab. 5 summarizes the site's strengths and weaknesses, serving as direct input for quantitative processing using the AHP method.

Table 5 Summary of Strengths and Weaknesses of the Veľatý Site

Evaluation Area	Strengths (Potential)	Weaknesses (Barriers)
Natural potential	Presence of a unique mineral spring with high total dissolved solids	Absence of current certified analyses and medical validation
Spatial context	Direct inclusion in the Zemplín Geopark; high landscape value	Insufficient functional integration of the spring within the Zemplín Geopark activities
Safety	Calm rural environment; low level of anthropogenic disturbance	Poor vegetation maintenance; proximity to railway without safety barriers
Infrastructure	Basic elements present (revitalized spring core, shelter).	Lack of systematic maintenance; absence of sanitary facilities and lighting
Accessibility	Favorable location within the Košice Region (Trebišov – Sátoraljaujhely route).	Lack of navigation system; unpaved access for mobility-impaired visitors
Services	Potential synergy with the existing Aqua Maria complex	Lack of accommodation and catering facilities in the immediate vicinity
Spa tradition	Strong historical spa heritage associated with the Andrassy family	Historical context not visually or educationally presented
Visitor experience	High level of authenticity and natural character	Subjectively low service quality; lack of experiential elements

Based on the qualitative assessment of individual criteria, derived from field research and the author's analysis, the criteria were subsequently quantified. Each criterion was assigned a score on a scale from 1 to 5, where 1 represents a very low level of fulfilment and 5 a high level. The weighted score of each criterion was calculated as the product of the normalized weight and the assigned score. The final score is the sum of the weighted values and expresses the overall level of site attractiveness (Tab. 6).

Table 6 Evaluation of the Veľaty Site According to Criteria

Criterion	Actual Characteristics	Score	Weight [%]	Weighted Score
C1	Mineral water, lack of current analyses	3	9.12	0.27
C2	Historically documented effects, no modern validation	3	12.87	0.39
C3	Stable physical properties, lack of current measurements	3	8.05	0.24
C4	Absence of accommodation capacities at the site	2	10.94	0.22
C5	Limited catering services nearby	2	10.08	0.20
C6	Part of Zemplín Geopark, high natural potential	4	12.10	0.48
C7	Significant tradition, currently not presented	2	7.96	0.16
C8	Calm locality, poor maintenance and risks	3	16.93	0.51
C9	Good regional accessibility, deficient signage	3	11.94	0.36

The total weighted score reached 2.83 (out of a maximum of 5.00), indicating a moderate level of attractiveness of the Veľaty site. The site demonstrates significant natural potential, particularly reflected in the criteria of proximity to natural attractions (C6) and the therapeutic potential of the spring (C2). Accessibility (C9) is also evaluated relatively positively. On the other hand, lower scores were observed in criteria related to infrastructure and services, specifically accommodation (C4), catering services (C5), and the spa tradition (C7), which is currently underdeveloped. For the important criterion of site safety (C8), the average rating indicates a need for improvement, particularly in environmental maintenance and visitor comfort. Based on the multicriteria evaluation, it can be concluded that the Veľaty site has significant potential for tourism development. However, this potential is not currently fully utilized. To enhance its attractiveness, it is essential to improve infrastructure, service quality, and overall site management.

The resulting score highlights a pronounced disparity between high natural and historical potential and low material and technical infrastructure. To reach a high attractiveness level (above 4.00), it is necessary to transform the spring's "passive" potential into an "active" tourism product through investments in services and systematic destination management.

Proposed Measures for the Development of the Veľaty Site

Based on the multicriteria evaluation, which identified critical disparities between potential and actual conditions (overall score 2.83), a set of measures was formulated to eliminate barriers and strengthen the area's competitive advantages. The proposed interventions are hierarchized according to their impact on key criteria C1 - C9.

Priority Measures in the Areas of Safety and Infrastructure (C8, C4, C5)

Given that safety and the level of site maintenance were identified by experts in the AHP analysis as the most significant factors (weight 16.93 %), the first step toward enhancing the attractiveness of the site must be its comprehensive physical revitalization and the development of basic tourism infrastructure. The proposed measures include: Vegetation management and remediation (C8): Implement regular maintenance around the spring and systematically remove invasive vegetation. These steps will improve site visibility, reduce the sense of isolation, and significantly enhance visitors' perceived safety. Installation of safety infrastructure and lighting (C8): Deploy solar lighting and safety features (e.g., fencing along the railway line) to improve visitor comfort, especially during evening hours. Development of basic tourism infrastructure and services (C4, C5): As the availability of accommodation and catering has been identified as the weakest aspect of the site, the following measures are proposed: Support for partnerships: Development of cooperation with surrounding municipalities and local businesses to create a network of accommodation and catering services within the wider region. Supplementary on-site services: Establishment of space for seasonal complementary services (e.g., mobile refreshments, local product sales, rental of recreational equipment), enhancing visitor comfort without requiring extensive construction interventions in the natural environment. Utilization of synergies: Encouraging private investors to expand accommodation capacities in Veľaty, with the Slaná studňa spring serving as a unique secondary attraction for guests using existing facilities in the region. *These measures aim to transform Veľaty from a transit point into a place where visitors feel safe and have access to facilities that meet modern tourism standards.*

Valorisation of Natural (C1, C2, C3) and Historical Capital (C7, C6)

To transform the "passive" therapeutic potential into a marketable product, the following steps are proposed: Professional verification of resource properties (C1, C2, C3): Certification and analysis of composition (C1): Conducting comprehensive physical and chemical analysis (iodine, bromine content, total dissolved solids), enabling the legitimate use of the term "therapeutic potential". Medical and historical evaluation of effects (C2): Preparation of an expert study defining specific health indications (e.g., respiratory conditions) based on water composition (C1) and source stability (C3). Monitoring of physical stability (C3): Regular measurement of discharge and temperature to ensure quality assurance for planned experiential and educational activities. Interpretation of spa heritage (C7): Outdoor exhibition: Creation of an information point presenting the history of

the Aqua Velejtenis spa and its connection to the Andrassy family through interactive panels. Revitalization of „genius loci“: Organization of events such as „Slaná studňa day“, linking local gastronomy with historical spa context. Identity presentation: Use of historical spa symbols in the municipality's visual communication to strengthen local identity and brand perception among visitors. Integration into the Zemplín Geopark structures (C6): Educational programs: Develop educational modules in cooperation with the geopark, focused on hydrology, balneology, and resource protection, thereby enhancing the site's social significance. Regional synergy effect: Include the spring in official geopark maps and routes to ensure the inflow of organized geotourism groups.

Networking and Product Development (C9, C4, C5)

The key to sustainable development lies in transforming an isolated natural resource into an integrated tourism product. The main tool for this transformation is linking the point attraction (the spring) with an established recreational service center in the municipality (the Aqua Maria complex). Creation of the linear product „Slaná cesta (Salt Trail)“ (C9): Thematic educational trail: Development of a trail physically and conceptually linking the Aqua Maria recreational area with the historical Slaná studňa spring. This transforms short, incidental visits into a more comprehensive visitor experience. The trail should serve not only as a communication corridor but also as an educational platform that presents the area's geology and hydrogeology. Integrated information and navigation system: Implementation of unified visual signage throughout the municipality and along main access routes. Directional signs and QR codes linked to Zemplín Geopark digital content will significantly improve visitor orientation and enhance the site's technological level. Optimization of accessibility and service quality (C4, C5). Utilization of existing infrastructure: Strategic linkage with the Aqua Maria complex allows for the immediate elimination of deficiencies in accommodation (C4) and catering (C5). Visitors to the spring gain access to existing facilities, while the complex expands its offer with an authentic natural-historical element. Improvement of visitor comfort: Through integrated management of both sites, it is possible to ensure higher service standards (hygiene, waste management, souvenir sales), directly contributing to an increase in the site's overall weighted attractiveness score.

Implementation Timeline of Development Measures

Implementing these networking measures will enable the municipality of Veľaty to move beyond its role as a transit destination and develop a comprehensive tourism offer that encourages longer stays and repeat visits. The proposed measures can be systematically divided by time horizon, as presented in Tab. 7.

Table 7 Implementation Timeline and Strategic Focus of Measures

Time Horizon	Category of Measures	Key Activities and Objectives
Short-term	Remediation and navigation	Physical revitalization of the spring surroundings, removal of waste and invasive vegetation, installation of a basic navigation system (C8, C9).
Medium-term	Infrastructure and quality	Development of the „Salt Trail“ educational path, certification of mineral water, construction of basic sanitary facilities, and staff training (C1, C2, C4, C5)
Long-term	Branding and synergies	Formation of a destination brand, integration into international geotourism networks, development of comprehensive experiential products in cooperation with regional partners (C6, C7).

Implementing these steps will transform the Veľaty site from a passive natural resource into an active, safe destination, reflected in an increase in the area's overall attractiveness index.

Strategic Integration of the Locality within Regional Infrastructure

To achieve long-term sustainability, it is essential to perceive Veľaty as an integral part of the regional tourism ecosystem. The transition from an isolated attraction to a network-based product requires synergy across three strategic dimensions:

- Utilization of financial mechanisms (NRO): The locality falls within the priorities defined in the Trebišov District Action Plan for least-developed regions. This position enables the municipality to access systematic support aimed at reducing regional disparities. Investments in the revitalization of the Slaná studňa spring thus represent not only a local initiative but also a contribution to the economic revitalization of Lower Zemplín through the development of rural tourism and cycling tourism.
- Destination synergy (Tokaj and Zemplín Geopark): The geographical proximity of the Tokaj wine region and membership in the Zemplín Geopark create favorable conditions for product clustering. Veľaty can function as a „gateway“, connecting geotourists with visitors seeking geological, cultural, and gastronomic experiences (e.g., the Geoscientific exhibition in Malá Tŕňa, the Mausoleum of Count Gyula

Andrássy in Trebišov, or the observation tower in Malá Tŕňa). Such networking enhances the region's overall attractiveness and encourages multi-day stays.

- Service integration and product linkage: A key operational step is the functional linkage between the Slaná studňa spring and the Aqua Maria complex. Transforming these two points into a coherent linear product (via the proposed educational trail) enables more efficient use of existing accommodation and catering capacities. This approach addresses identified infrastructure gaps (C4, C5) without requiring immediate large-scale investments in new construction, thereby maximizing return on investment.

Strategic integration with existing regional structures thus represents a key development accelerator, enabling the transition from point-based use of the area to systematic and sustainable destination management.

Conclusion

This study provides a comprehensive assessment of the development potential of the Veľaty site, with particular emphasis on the Slaná studňa mineral spring. The multicriteria evaluation confirms that the area possesses significant natural and historical capital. The high level of total dissolved solids and the location within the Zemplín Geopark provide a solid foundation for balneotourism and experiential-educational activities.

The results gain particular importance in the context of the Trebišov District Action Plan (NRO). Financial mechanisms approved for the Lower Zemplín in 2025 create new opportunities for developing cycling tourism and cross-border cooperation, positioning Veľaty as a potential strategic node. Given its proximity to the Tokaj wine region, the municipality appears well suited to function as a regional gateway.

The answers to research questions RQ1-RQ3 provide additional interpretative insight into the multicriteria analysis:

- RQ1: Experts identified site safety (C8, 16.93 %) as the most important factor influencing visitor decision-making, followed by the therapeutic potential of the spring (C2, 12.87 %) and natural attractiveness within the Zemplín Geopark (C6, 12.10 %). Infrastructure factors such as accommodation (C4) and catering (C5) occupy a mid-level position, while historical context (C7) and technical water parameters (C1, C3) are perceived as secondary. These findings confirm that visitors prioritize safety and functional natural potential over aesthetic or cultural-historical aspects.
- RQ2: The analysis revealed a low level of correlation between the high natural potential of the spring (C1-C3; score 3/5) and the current state of supporting services (C4, C5; score 2/5). This disparity is reflected in the weighted scores: natural potential ranges from 0.24 to 0.39, while services range only from 0.20 to 0.22. The Slaná studňa spring thus represents a „passive“ therapeutic resource not supported by adequate infrastructure, highlighting untapped development potential and identifying service infrastructure as a priority investment area.
- RQ3: The analysis revealed insufficient synergy between the historical spa tradition (C7) and modern requirements for safety (C8) and visitor comfort. Although the spa heritage associated with *Aqua Velejtenis* and the Andrássy family represents a valuable identity element, it is not currently presented visually or educationally (C7; score 2/5). Site safety (C8), despite its highest weight (16.93 %), achieved only an average score of 3/5 due to inadequate maintenance and risks associated with the nearby railway. The absence of synergy between these factors reduces overall attractiveness. A combined revitalization approach – improving safety conditions (C8) and simultaneously interpreting spa heritage through exhibitions and events (C7) – would significantly enhance visitor value.

The application of the Analytic Hierarchy Process (AHP) enabled the objective identification of key development constraints. The highest importance was assigned to site safety (C8), therapeutic potential (C2), and accessibility (C9). The resulting score of 2.83 (on a scale of 1–5) places the site in the moderate-attractiveness category, confirming significant untapped potential, where natural assets exceed infrastructure and service quality.

The proposed measures focus on eliminating identified barriers. Priority should be given to physical revitalization, improved safety, and subsequent certification of the resource, enabling the transformation of a „passive“ spring into a recognized therapeutic product. The creation of the „Salt Trail“ and its integration with the Aqua Maria complex represents a key strategy for transitioning from an isolated attraction to an integrated tourism product.

The site's future success will depend on local authorities and the private sector creating synergies with nearby attractions. Although the research is limited by subjective expert evaluation, it provides a clear methodological framework for development. Future research should focus on monitoring visitor satisfaction and quantifying the economic multiplier effects of the proposed revitalization for the local community.

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