Article

The Landscape of the Spa Parks Creation through Components Influencing Environmental Perception Using Multi-Criteria Analysis

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Abstract: The improvement of the landscape of spa parks should result from the planned directions of development and the most important tasks of the spatial policy of spa towns. Their proper management significantly impacts the region’s economic growth: the labour market, the size and type of new financial investments, and the natural environment. The basis of activity in the areas of spa parks is the balancing of elements of the natural, cultural and historical background. Parks are health protection zones, health ecosystems—separated from the spa zone to protect healing and environmental values. These areas should be characterized by rational landscaping. The spatial layout of park areas should consider the appropriate zones (healing, silence, recreation). The leading element that allows separating sub-areas in parks is the layout of alleys and greenery. The attractiveness of parks is also influenced by factors related to spa activities. The article aims to indicate the main criteria affecting the perception of the landscape of spa parks. Their meaning was determined by information entropy. A selection of criteria defining the landscape assessment and influencing the perception of spa greenery, which helped determine how to shape and develop the spa park, was presented. Data obtained from actual field measurements on factors influencing the reception and perception of spa parks were considered. The multi-criteria method of comparative analysis allows one to quickly and transparently determine the hierarchy of the most advantageous variables from the adopted criteria. The study confirmed that the smaller the sum of adverse elements affecting the shaping of the park spatial, the better residents’ and patients’ perception of the park.

Keywords: health resort; historical gardens; ecosystem; greenery; revitalization; multi-criteria analysis; Poland

1. Introduction

Conscious shaping of spa parks aims to balance the development of services to improve health and protect the (most often historic) compositional layout. Therefore, it seems essential to take care of the proper shaping of the reception/perception of the park as one of the many components affecting the attractiveness of the place. At the same time, environmental protection is essential as one of the criteria for urban planning and responsible local policy [1]. Spas are recognized by the ESPA (European Spa Association) as places of natural medicinal value, scientifically proven and will be part of scientific medicine [2]. They are often equipped with traditional healing architecture (e.g., medical spa resort, pump room, graduation tower), accompanied by greenery in compositional arrangements. Classic treatments in spas are, for example, balneotherapy and climate therapy [3]. That is why greenery is such an essential and vital feature, which positively affects the urban landscape and environmental values (reduces the spread of dust, gases and noise). It also provides the spatial necessary for recreation.
The environment has one crucial function in spas—it is a therapeutic element. This feature is highlighted in their publications by many authors. For example, Yli-Panula et al. [4] cited the definition of the landscape based on the provisions of the Landscape Convention of the Council of Europe [5]. This document defines landscape as people’s perception of an area created by humans or natural phenomena. The landscape here is a smooth combination of natural and urban landscapes.

Gesler [6,7] emphasizes the environment’s importance in correlation with the culture of the environment and the health of the recipients. Irvin et al. [8] expose the potential of the environment, especially greenery, about its health benefits. Green has a positive effect on emotions (calms) and relaxes. This is especially important in spa parks with their dominant health function. Factors associated with the landscape and its therapeutic function stimulate or destimulate its properties [8,9]. The article pays special attention to the soundscape.

A soundscape is defined as the full range of sounds experienced in a given landscape at a particular time and the way people respond to these acoustic signals. Soundscape research aims to collect information about the environment (e.g., identification of sound sources, zoning, spatial layout—alleys and their surface, surroundings) and about the subjective perception of sounds that are components of this environment [10].

Spas, as localities, influencing the well-being of residents, particularly residents, should be shaped in such a way as to ensure the use of their healing character. Parks form the central part of the spa. The choice of greenery also shapes the soundscape of the spa park, which is influenced by the type of transport generating traffic noise. Also, accessibility, places and number of spatial services, and other attractions, can be separated based on properly developed greenery. The spa greenery is the primary source of contact with nature for the inhabitants of spa towns and patients. Well-organized green spatial is increasingly seen as an essential factor in the quality of life [11]. Many studies have shown that proper management of these areas can reduce stress and relieve anxiety [12–15]. In particular, studies of open green spaces have shown a strong correlation between assessed serenity and the percentage of visitors who feel more relaxed after visiting parks [16,17]. The models and indicators proposed in the literature for assessing the quality of green areas in terms of development and impact on the soundscape can help planners, designers, and decision-makers create scenarios for improving spa areas [18]. The proposed approaches are a valuable asset because development strategies and local plans may harm the improvement of the quality of life in the vicinity of spa areas [19]. The use of the park is inextricably linked with the surroundings. An essential element is the accessibility, quality and perception of the park and the cultural preferences of the inhabitants [20]. Sustainable development of recreational spatial is important, especially in spas, and should consider solutions to reducing climate risk and mitigating its effects [21]. There is a lack of robust and scientific methodologies for assessing the quality of green spatial, especially from the user’s perspective. Most studies consider individual aspects of the spa park, e.g., profitability of the investment [22], greenery in visual [23] or acoustic [24] terms. Reviewing the results obtained by other researchers, we can conclude that, to our knowledge, no publications are assessing the landscape shape of spa parks with multi-component criteria.

Undoubtedly, green areas and their attractiveness are judged based on visitors’ perceptions. One of the main factors influencing the assessment of the quality of spa park areas is pollution and, above all, noise. This essential element cannot be overlooked when analyzing these areas. Understanding the subjective feelings of recipients about the sources of noise is a helpful tool in determining how to shape and develop spa parks. In his article, Watts [17] based on the determined coefficient of “calming” indicated in the analyzed parks, specially designed walking routes that allow residents and visitors to rest and recover from stress. A good element was the perception of the environment. Gobster, Ribe and Palmer believe that ambient quality, sound and landscape are significant factors in the perception of the environment, especially in its recreational use [18]. They agree that the quality of sound generated in the landscape increases and affects its perception in some situations.
Soundscape research is an example of growing interest, including noise and tranquility mapping [25,26]. Particularly important is the noise coming from the roads surrounding the parks. Jiang and Kang [26] investigated the impact of street noise on the perception of the soundscape in the park. On the other hand, Joo et al., Votsi et al. and Radicchi and Vida, describe the most common feelings of visitors based on associations of soundscapes with landscape structure, composition, and distance from roads [27–29]. As already mentioned, the greenery used in urban arrangements improves the health and well-being of people and changes the environment, especially sound. The authors of many works pay special attention to the importance of the distribution of vegetation for the recipient/position of the listener (reflection, diffraction, scattering and absorption of sound) by vegetation. Publications [30–33] describe screens using natural vegetation, in which the soil substrate plays an important role (good sound-absorbing properties). Many authors also note hedges as a good insulator of external sounds. Also, the very presence of greenery as a shielding element, limiting the sound source, positively affects listeners, minimizing acoustic effects [34–40]. Subjective sensitivity to noise depends on the physiological predisposition of a person and the properties of the sound itself. The use of various methods of presentation and valorization of sensations through the creation of noise maps, acoustic cognitive maps or the use of computational methods (based on statistics or artificial intelligence or multi-criteria analysis) is aimed at minimizing the adverse impact of noise on the environment and applying appropriate policies towards the development of park areas. The literature also includes models of perception of other environmental pollutants based on GIS tools [41–43]. They allow for the analysis of subjective assessments of the quality of selected features in the studied area [23,44,45].

The location and size of the spa zone are important factors determining the quality of rest. Problems arise in spas with preserved historical sites and protected monuments. Often, it creates a conflict between the efforts of conservation services to keep the objects intact and the medical requirements related to the need to introduce new techniques and methods of treatment in buildings located near healing springs [15]. The revitalization of the spa may concern the whole town or a significant part of it and involves the need to rebuild and revive the facilities related to the stay of patients and the arranged green areas that form the basis of this therapy [46]. Revitalization projects aim not only to provide favourable economic conditions but even to create a new, attractive public space of the city and health resort, with high quality of development and arrangement, with extensive green areas, which ensures the implementation of the postulates of sustainable development [47,48].

To provide access to the greenery for the constantly increasing number of inhabitants, cities strive to improve the absorbency of recreational areas and spa parks. The renewal and modernization of these areas involve a change in their utility programs (introduction of additional services and public spaces). This, in turn, correlates with an increase in the number of visitors to parks, which results in an increased noise level (change in the acoustic landscape). The authors aim to formulate a set of criteria that support the management of spas with various types of variables affecting the therapeutic landscape.

Spa parks are a particular type of recreation area with health benefits. The authors have been analyzing the park’s development to the factors shaping their therapeutic landscape for a long time. They analyzed the criteria that determine the attractiveness of these areas and asked visitors—which criteria do they think are essential in spa parks? The results of the surveys were aggregated, and the most important criteria responsible for perceiving their attractiveness were distinguished. The awarded criteria assessed the beauty of three spa parks in Inowrocław, Ciechocinek and WieniecZdrój. The article fills a research gap by presenting a method to compare spa parks to allow decision-makers committed to promoting sustainable development to analyze the implications of economic, environmental, social and cultural factors at the same time. The article aims to indicate the main criteria influencing the perception of the landscape of spa parks. The issue of the revitalization of modern spa towns should be based on the use of vegetation and green infrastructure to create spatial friendly public in health resorts.
2. Materials and Methods

Research and analysis were carried out for three spa parks. The basic assumptions of the presented research concern the following aspects:

- emphasizing the desirability of introducing landscape perception analyses when designing green areas, especially spa parks in the urban spa landscape;
- analysis of the degree and causes of noise in the park and its surroundings and based on own noise measurements;
- finding and evaluating the main criteria with the impact on the spatial design of spa parks;
- determining the impact of the criteria on the decisions taken through the use of information entropy;
- comparison of the three spa parks described in the study as a direct and tangible example of the possibility of assessing the park using the proposed method.

2.1. Study Area

The selected research areas are three spa parks located in the Kujawsko-Pomorskie Voivodeship (Figure 1). Ciechocinek, Inowrocław and Wieniec Zdrój are spa towns.

![Figure 1. The research area location.](image-url)
The city of Inowroclaw is the most significant health resort in the voivodship, with a population of about 73,000. It is a considerable railway and road junction and an industrial centre. The spa park is the largest city park. The health resort in Inowroclaw was established in 1875. Initially, the Spa Garden (Solanki 1) occupied 5 ha, and now it occupies an area of about 85 ha. Due to the salinity of the soil, deciduous trees predominate (maples, ash trees, chestnut trees, lindens, maples, oaks, plane trees, pines and rare trees—coastal willow). The central part of the park is under conservation protection. The city of Inowroclaw is a zone with a very high concentration of industrialization, with numerous plants classified as large emitters of pollution. The spa area results from human activity aimed at arranging a spa park and infrastructure for the use of medicinal waters [49]. Most of the spa infrastructure developed in the city are accommodation facilities and for the implementation of medical treatments. Due to the extensive combination of greenery, the area of the spa has an essential ecological function. The function is valuable because there are no forest areas or even large, dense trees and shrubs in the city and its surroundings. The most critical functions of the spa include:

- location in the structure of a large city with different functions, with a part of the analysis area reaching the strict central part, with compact buildings,
- analysis of the greater part of the area serving as a health resort (the new part of the spa is in the area excluded from the boundaries of the study),
- the health resort plays an important social role of supra-local importance (Inowroclaw is one of the largest spas in Poland) and local (as a recreation area for city residents),
- the decisive importance of the spa function over all other activities carried out in this part of the city [49].

Ciechocinek is the second largest health resort of the Kujawsko-Pomorskie Voivodeship. The number of inhabitants does not exceed 11,000. There is no industry in the city. In the northern part of the city, there is a spa park—the largest of the four parks of Ciechocinek. It was built in the years 1872–1875, according to the design of Hipolit Cybulski. Located in the central part of the city, it covers an area of about 18.21 ha. It is located in zone “A” of spa protection [50]. Attractive old-growth trees with a predominance of deciduous species grow in the park.

Wieniec Zdrój Health Resort is one of the oldest health resorts in Kuyavia. It was founded in 1923 and is surrounded by pine forests with juniper thickets. The stand is dominated by pine with an admixture of birch. The area of the park is about 10 ha. There are medical facilities in the area. Since 1997 the park has been entered the register of monuments as an example of a forest spa park [51].

The functions with the most significant impact on spatial design have been defined in all parks. These are the determinants of decision-making, of which 14 have been identified (Table 1).

Noise in the parks was measured using the sampling method. Measurement points were selected in places that characterize the spatial acoustically. The obtained results of the equivalent sound level allow to analyze the area acoustically and refer to the applicable standards for zones A of spa protection [52]. Also, the alas in the park is influenced by the class and intensity of traffic on the neighbouring streets. Furthermore, the spatial layout of parks, greenery and biodiversity, plant area, and development elements give information about their impact on the attractiveness of spas. The park’s surroundings, NNI, records in documents, users and their subjective assessment of the garden’s beauty complete the park’s characteristics.

Various analyses are performed to properly assess the landscape in a given area, considering the obtained data.
Table 1. Identified variables influencing decisions.

<table>
<thead>
<tr>
<th>Variables Used in the Decision-Making Process</th>
</tr>
</thead>
<tbody>
<tr>
<td>The noise level in dB—value measured at measuring points</td>
</tr>
<tr>
<td>Scenery—surface and forms of greenery (multi-storey layouts)</td>
</tr>
<tr>
<td>Sheathing, biodiversity—the dominant number of species in the structure of plants</td>
</tr>
<tr>
<td>Water—the number of objects or the availability of water zones</td>
</tr>
<tr>
<td>Park buildings—visibility, compactness, and height of buildings (zone 50 m around the park)</td>
</tr>
<tr>
<td>Index of the nearest neighbours</td>
</tr>
<tr>
<td>Economic conditions—the amount of property tax</td>
</tr>
<tr>
<td>Plant area—% vegetation in the park</td>
</tr>
<tr>
<td>Population—the number of users of the park</td>
</tr>
<tr>
<td>Development plans—the possibility of enlarging the area of the park</td>
</tr>
<tr>
<td>Records of planning documents</td>
</tr>
<tr>
<td>The attractiveness of the park, according to the study</td>
</tr>
<tr>
<td>Class and volume of traffic on the streets adjacent to the park</td>
</tr>
<tr>
<td>Building elements</td>
</tr>
</tbody>
</table>

2.2. Multicriteria Analysis and Information Entropy

In spatial analysis, multi-criteria analysis was used, supplemented by information entropy as a tool of an objective and logically justified method of determining the weights (influences) of individual criteria. Multi-criteria analysis and sustainability issues can be carried out using mathematical, geometric and taxonometric methods based on graph theory and artificial intelligence [47,53]. The optimal choice of method depends on many factors, among which it is worth mentioning the subjectivity of the solution obtained. This factor is important in planning and spatial development, landscape architecture or construction [48]. In these activities, the knowledge of experts is used. To minimize errors resulting from the subjective expert’s opinions regarding the impact of individual criteria, information entropy was used to determine the weights in this work. In the research presented in the article, mathematical methods were used. A multi-criteria benchmarking algorithm using these methods, together with an indication of the possibility of entropy, is shown in Figure 2. More information about the possibilities and ways of using multi-criteria analysis can be found m.in in the articles [54–56].

![Figure 2](image-url)

Figure 2. Decision support algorithm by the method of multi-criteria analysis with the use of information entropy.

The use of information entropy makes it possible to estimate the importance of individual analyzed criteria based on the discrepancy in assessments of the considered solution variants concerning each criterion. This approach allows for objective determination of
weights without relying on experts’ knowledge [57–60]. The algorithm for determining weights with the use of information entropy is presented below [61]:

1. construction of an \( X \) decision matrix containing data necessary for alternative comparison. This is example 1 of an equation:

\[
X = \begin{bmatrix}
x_{11} & x_{12} & \ldots & x_{1n} \\
x_{21} & x_{22} & \ldots & x_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
x_{m1} & x_{m2} & \ldots & x_{mn}
\end{bmatrix}
\] (1)

where: \( x \)—measure of the variant \( m \) to the criterion \( n \);

2. determination of a modified decision matrix \( P \).

\[
P = \begin{bmatrix}
p_{11} & p_{12} & \ldots & p_{1n} \\
p_{21} & p_{22} & \ldots & p_{2n} \\
\vdots & \vdots & \ddots & \vdots \\
p_{m1} & p_{m2} & \ldots & p_{mn}
\end{bmatrix}
\] (2)

the elements of which are determined depending on the nature of a given criterion: for a stimulant \( p_{ij} = x_{ij} \), while for destimulants \( p_{ij} = (x_{ij})^{-1} \).

3. matrix normalisation \( P \).

\[
r_{ij} = \frac{m_{ij}}{\sum_{i=1}^{m} m_{ij}}
\] (3)

consequently, a normalized matrix is obtained \( R \),

4. computing a value of \( E \) resulting from the decision information contained in the matrix \( R \) for each criterion.

\[
E_j = -K \sum_{i=1}^{m} r_{ij} \ln r_{ij}
\] (4)

where: \( K \) is a constant guaranteeing that \( 0 \leq E_j \leq 1 \) designated as \( K = (\ln m)^{-1} \).

5. calculating the degree of internal discrepancy in assessments against individual criteria \( d_j \).

\[
d_j = 1 - E_j
\] (5)

determining the weights of individual criteria \( w_j \).

\[
w_j = \frac{d_j}{\sum_{i=1}^{n} d_i}
\] (6)

The result of the multi-criteria analysis is to find the most favorable variant in terms of the adopted criteria. The presented work concerned the most practical solution for the spa park, considering the acoustic climate. For this purpose, the value of each variant should be calculated using one of the synthetic formulas, which in the case of the conducted research is the corrected summation index, defined as [47]

\[
J_i = \sum_{j=1}^{n} (p_{ij}w_j)
\] (7)

where: \( J \)—value of individual variants (weighted sum indicator).

Three variants were adopted for the research, corresponding to the three spa characteristics (Figure 3).
The variants were based on criteria influencing the evaluation of the soundscape of the parks. The criteria are presented in Figure 4.

**Figure 4.** Criterion influencing the assessment of the soundscape of three variants of spa parks.

Sound level measurements were made by the principles set out in the State Inspectorate for Environmental Protection instructions entitled “Methods of measuring external noise in the environment” with corrections adapted to the purposes of this study. The acoustic...
data were collected using the sampling technique approved by the PN-ISO 1996-2:1999 standard. The measuring points have been located in such a way as to best represent the park’s soundscape. Attention was also paid to ensure that the noise measurements made were carried out under appropriate atmospheric conditions:
- temperature range from $-10$ °C to $40$ °C,
- humidity from 25% to 98%,
- average wind speed up to 5 m/s,
- atmospheric pressure from 940 hPa to 1060 hPa.

The determined indicator was the equivalent sound level $L_{Aeq}$.

An essential issue in shaping the spatial green areas is to find solutions that can be used in parks so that they do not change existing systems. The noise is an authoritative criterion here, which is why acoustic plans in parks are developed in the first place to get to know the sound system (Figure 5).

![Figure 5. Acoustic climate plan.](image)

Until now, in the planning documents of spa towns, no attention was paid to protection against excessive noise. Due to the large share of vegetation, it was assumed that these areas are quiet. Currently, noise protection regulations are becoming more and more frequent, especially in areas A of spa protection. Such records also appear in the documentation of the analyzed parks. They mainly concern road and rail traffic noise. All analyzed buds are under conservation protection, which results in restrictions on changes on their surface. Acceptable levels of equivalent sound level should not exceed 45 dB during the day. In the analyzed parks, these values are exceeded and result primarily from the surroundings of access roads. All identifiable sound sources were taken into account in the measurements and were not separated from each other. It determines the spatial design of the soundscape in the park. To improve the existing soundscape, revitalization works are successful in the
parks. In all gardens, the surface of walking paths has been replaced. First of all, concrete blocks and gravel were used (however, these are not quiet surfaces). The roads surrounding the parks have asphalt pavement.

The impact of parks on rest comfort can be examined based on surveys among park visitors.

The main questions of the survey concerned:

- the frequency of visits to the park,
- the time of the visit,
- the purpose of the visit,
- type of perceived sound sources—respondents chose from the following types of noise: cars, trams, buses, adults, children, fountain, leaf noise, others (list which);
- the level of perceptible noise—low, medium, high, very high.
- The respondent’s data included information about gender (male, female), age (4 ranges: under 25 years; 25–45 years; 46–65 years; over 65 years), place of residence (city, village).

The survey contained an anonymous clause and information about the research purpose. Respondents in the parks in Ciechocinek and Inowrocław mentioned cars and visitors to the park as the dominant sources of disturbing leisure. These studies help manage such an area combined with noise measurements and land use analysis. Then they are an essential element of sustainable management and design spatial of spa parks and urban health resorts. In all parks, you can separate zones with a similar purpose—silence, recreation, and healing. However, specific sub-areas are sometimes tricky due to the park’s size. For example, in the spa park in Wieniec Zdrój, it is challenging to separate zones; the louder zone becomes a quiet zone as you move away from the road. To minimize the impact of cars on the park, dense rows of trees and shrubs dominate in the vicinity of the main communication route. A loose strand of trees characterizes the spa park in Ciechocinek. The park area is used for walking and sports, and the part next to the concert shell is an entertainment zone. The spa park in Inowrocław, due to its area, distinguishes many different types of subareas. Quiet, central zones with dense vegetation of trees and shrubs and entertainment zones centred around the main communication route. Around the graduation tower, there is a zone related to a spa treatment. It is separated from the neighbouring railway junction by an embankment overgrown with grass. The rest of the park is a loose stand of trees.

3. Results

3.1. Comparative Analysis of the Adopted Variants of Spa Parks

Relief parks are part of health resorts; they affect the formation of the urban landscape and create a climate conducive to treatment. The spatial composition contains elements characteristic only for this type of terrain. The social and entertainment life organization also plays an essential role in spas. Hence, in the analyzed parks, there are entertainment facilities: sports facilities, tennis courts, playgrounds, and concert shells. Conscious spatial design and improving cities’ climate is critical in planning parks.

Using a multi-criteria method of comparative analysis in the decision-making process requires formulating an initial set of criteria, including critical features that would allow a given decision to be considered as leading to the assessment of the acoustic climate of spa parks. Such necessary characteristics (in the case of a search for a subjective evaluation) may include noise level (considered acceptable according to standards), land use and its value, the Nearest Neighbourhood Index (NNI) [62], planning records on land availability for such type of investment or maximum distances from communication infrastructure; as outlined in Section 2.1. Study area and detailed in Table 1, a set of 14 criteria was adopted for analysis. The measure values of each criterion are shown in Table 2.
Table 2. Set of criteria—values of unit measures.

<table>
<thead>
<tr>
<th>Criteria (Measures)</th>
<th>Ciechocinek</th>
<th>Inowrocław</th>
<th>Wieniec Zdrój</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maximum noise level dB (destimulant)</td>
<td>66 dB</td>
<td>59 dB</td>
<td>55 dB</td>
</tr>
<tr>
<td>Scenery—green areas (stimulant)</td>
<td>18.21 ha</td>
<td>55 ha</td>
<td>10 ha</td>
</tr>
<tr>
<td>Plating, biodiversity (stimulant)</td>
<td>coniferous stand, deciduous stand</td>
<td>The predominance of deciduous stands</td>
<td>The predominance of deciduous stands</td>
</tr>
<tr>
<td>Water—objects number or availability of water zones (stimulant)</td>
<td>one pond with a fountain, two freestanding fountains</td>
<td>two ponds with fountains, a freestanding fountain</td>
<td>fountain</td>
</tr>
<tr>
<td>Park housing—compactness and height of buildings (destimulant)</td>
<td>single-family houses, guest houses, sanatoriums up to two floors</td>
<td>single-family houses, guest houses, sanatoriums up to eleven floors</td>
<td>sanatoriums up to five floors</td>
</tr>
<tr>
<td>Nearest Neighbor Index (destimulant)</td>
<td>1.6</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>Economic conditions (destimulant)</td>
<td>property tax for 1 m²—0.66 PLN—21.20 PLN spa tax—4 PLN</td>
<td>property tax for 1 m²—0.80 PLN—23.90 PLN spa tax—4.45 PLN</td>
<td>property tax for 1 m²—0.50 PLN—23.90 PLN spa tax—3.60 PLN</td>
</tr>
<tr>
<td>Plant area % (stimulant)</td>
<td>80%</td>
<td>75%</td>
<td>80%</td>
</tr>
<tr>
<td>Availability/absorption, number of people, park users (stimulant)</td>
<td>ok. 2250/period</td>
<td>ok. 3000/period</td>
<td>ok. 1200/period</td>
</tr>
<tr>
<td>Planning conditions: development plans—the possibility of increasing the park area, protection of the establishment (stimulant)</td>
<td>local spatial development plan spa resort park entered in the register of monuments</td>
<td>local spatial development plan spa resort park entered in the register of monuments</td>
<td>local spatial development plan park entered in the register of monuments</td>
</tr>
<tr>
<td>Perception/attractiveness of the park, according to the survey (stimulant)</td>
<td>high</td>
<td>very high</td>
<td>very high</td>
</tr>
<tr>
<td>Traffic class and volume on the streets adjacent to the park (destimulant)</td>
<td>rail main road</td>
<td>rail main road</td>
<td>municipal road</td>
</tr>
<tr>
<td>Building elements (stimulant)</td>
<td>fountain, dense vegetation (lane vegetation—hedges), loose tree stand, grass cover</td>
<td>fountain, dense vegetation (lane vegetation—hedges, dense plantings of shrubs), loose tree stand, grass cover, embankment</td>
<td>fountain, dense vegetation (lane vegetation—hedges), forest stand—loose, undergrowth (moss, grass)</td>
</tr>
</tbody>
</table>

The criteria and values were obtained based on noise measurements, surveys and planning documents of the analyzed parks. In the case of features that positively or negatively affect spatial evaluation, the focus was on maximum values. Studies have shown that the final assessment influences a given feature’s most favourable or unfavourable perception. Table 3 shows values based on relationships derived from the information entropy assigned to all analysis features.

According to the algorithm presented in Section 2.2, the weights of individual criteria were determined with the use of information entropy. The obtained values in the form of entropy \( E \), the degree of internal discrepancy of the ratings—\( d \), and the weights of individual criteria are summarised in Table 4.

According to Equation (5), the spatial was assessed in individual spa parks according to all criteria adopted in the analysis. The most favourable area prevails in the Wieniec Zdrój spa park. The highest value of the weighted sum index was determined based on the Equation (7), amounting to \( J_1 = 0.3519 \); the second in order is the spa park in Inowroclaw \( J_2 = 0.3399 \). On the other hand, the least favourable spatial place is the spa park in Ciechocinek, for which \( J_3 = 0.3082 \).

The conducted analysis results indicate the park in Wieniec Zdrój is the most valuable health-resort space. It is a forest spa park with the smallest area. Moved away from the city centres, away from busy streets, an enclave is separated from the Gostynin-Gostynin Forests. The fewest unfavourable elements affect the spatial shaping of this park. Respondents were least bothered by the noise in the park, which came only from cars located on access roads. Another park is Inowroclaw. Here, the dominant criterion is the park’s area and its attractiveness. The park in Ciechocinek has been rated the worst by visitors in terms of its friendly environment.
Table 3. Set of criteria measures for individual variants.

<table>
<thead>
<tr>
<th>Symbol</th>
<th>Criteria adopted for analysis</th>
<th>Ciechocinek</th>
<th>Inowrocław</th>
<th>Wieniec Zdrój</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-II-1</td>
<td>Maximum noise level dB (destimulant)</td>
<td>66</td>
<td>59</td>
<td>55</td>
</tr>
<tr>
<td>C-I-1</td>
<td>Scenery—green areas (stimulant)</td>
<td>18</td>
<td>55</td>
<td>10</td>
</tr>
<tr>
<td>C-I-2</td>
<td>Plating, biodiversity (stimulant)</td>
<td>2</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>C-I-3</td>
<td>Water—objects number or availability of water zones (stimulant)</td>
<td>2</td>
<td>3</td>
<td>1</td>
</tr>
<tr>
<td>C-II-2</td>
<td>Park housing—compactness and height of buildings (destimulant)</td>
<td>2</td>
<td>11</td>
<td>5</td>
</tr>
<tr>
<td>C-II-3</td>
<td>Nearest Neighbor Index (destimulant)</td>
<td>1.6</td>
<td>1</td>
<td>0.3</td>
</tr>
<tr>
<td>C-II-4</td>
<td>Economic conditions (destimulant)</td>
<td>15</td>
<td>17</td>
<td>16</td>
</tr>
<tr>
<td>C-I-4</td>
<td>Plant area % (stimulant)</td>
<td>55</td>
<td>75</td>
<td>90</td>
</tr>
<tr>
<td>C-I-5</td>
<td>Availability/absorption, number of people, park users (stimulant)</td>
<td>2250</td>
<td>3000</td>
<td>1200</td>
</tr>
<tr>
<td>C-II-5</td>
<td>Planning conditions: development plans—the possibility of increasing the park area, protection of the establishment (stimulant)</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
<tr>
<td>C-I-6</td>
<td>Perception/attractiveness of the park, according to the survey (stimulant)</td>
<td>4</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>C-II-6</td>
<td>Traffic class and volume on the streets adjacent to the park (destimulant)</td>
<td>4</td>
<td>4</td>
<td>2</td>
</tr>
<tr>
<td>C-I-7</td>
<td>Building elements (stimulant)</td>
<td>2</td>
<td>3</td>
<td>2</td>
</tr>
</tbody>
</table>

Table 4. Values of $E$, $d$, $w$ for individual criteria.

<table>
<thead>
<tr>
<th>Analysis Criteria</th>
<th>Entropy $E$</th>
<th>The Internal Assessment Discrepancy Degree $d$</th>
<th>Weight $w$</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-II-1</td>
<td>0.9975</td>
<td>0.0002</td>
<td>0.003</td>
</tr>
<tr>
<td>C-I-1</td>
<td>0.7820</td>
<td>0.2180</td>
<td>0.232</td>
</tr>
<tr>
<td>C-I-2</td>
<td>0.9602</td>
<td>0.0398</td>
<td>0.042</td>
</tr>
<tr>
<td>C-I-3</td>
<td>0.9206</td>
<td>0.0794</td>
<td>0.084</td>
</tr>
<tr>
<td>C-II-2</td>
<td>0.8067</td>
<td>0.1932</td>
<td>0.205</td>
</tr>
<tr>
<td>C-II-3</td>
<td>0.7745</td>
<td>0.2254</td>
<td>0.240</td>
</tr>
<tr>
<td>C-II-4</td>
<td>0.9988</td>
<td>0.0012</td>
<td>0.001</td>
</tr>
<tr>
<td>C-I-4</td>
<td>0.9822</td>
<td>0.0018</td>
<td>0.019</td>
</tr>
<tr>
<td>C-I-5</td>
<td>0.9305</td>
<td>0.0695</td>
<td>0.074</td>
</tr>
<tr>
<td>C-II-5</td>
<td>0.9821</td>
<td>0.0178</td>
<td>0.019</td>
</tr>
<tr>
<td>C-I-6</td>
<td>0.9952</td>
<td>0.0048</td>
<td>0.005</td>
</tr>
<tr>
<td>C-II-6</td>
<td>0.9464</td>
<td>0.0536</td>
<td>0.057</td>
</tr>
<tr>
<td>C-I-7</td>
<td>0.9821</td>
<td>0.0178</td>
<td>0.019</td>
</tr>
</tbody>
</table>

3.2. Discussion

Designing the composition of parks, including spa parks and public urban spaces, is usually performed without analyzing and assessing external factors such as noise. Unfortunately, the visual aesthetics in the current spatial urban does not ensure compliance with the accepted standards for assumptions related to health protection. As mentioned, green areas—parks—are areas that require special protection. Regarding sound level measurements, the permissible levels are exceeded everywhere in the analyzed areas. They are obvious on the borders of parks near spa streets. An approach combining physical, social and psychological stimuli in environmental acoustics is presented [1,10–12,40,43,45,62,63]. The authors present a framework of research and practical needs in the soundscape and an up-to-date set of activities, projects, and publications presenting current sound research and practice progress.

Publications [47,62] identified the most critical gaps in soundscape research and established future progress in this area. In the publication [63], Kang formulates several principles, including references to modulating perception using non-acoustic factors.
(e.g., visual) for both desirable and undesirable sounds and controlling unwanted sounds so that they are less noticeable. In all analyzed parks, there are fountains—an element of park architecture—which are the source of sound-emitting the so-called white noise.

The possibility of co-creating a sound project with a visual task in response to the need for a new approach to the urban spatial soundscape—the form of a “hackathon”—was also presented by De Winne et al. [64]. The authors of many articles also draw attention to the need to separate the quiet zones of the park from other zones of use. An important issue is using appropriate natural materials to separate subareas in green areas. The introduction of artificial barriers requires their proper integration into the environment. Often, park complexes are subject to conservation protection, and it is difficult to interfere with the historical layout of parks, as in the analyzed material.

Sustainable spatial management in which a person should feel comfortable is described in more detail in publications [10,40,65,66]. A suitable urban area positively affects all its elements and users. Therefore, it is necessary to define the criteria that have the most significant impact on urban spatial [67–69]. Nowadays, the lack of environmental stimuli in urban life can have adverse health effects [1]. In many studies, the term “green infrastructure” appears, which refers to the development of green areas, especially in cities [70–72]. The authors emphasize that spatial planning of new urban green increases the efficiency of urban green infrastructure and provides ecosystem services. Spatial planning actors describe this as a new approach that is expected to impact the environment and socio-economic dependencies significantly.

The article aims to choose the proper criteria for correctly modelling green areas. Planners and designers can use the proposed set of criteria and methods for developing results to interpret the public landscape and the mechanisms that guide its assessment by people—because a positive review affects the quality of life and fits the population’s needs. Also, the acquisition of output data—measurements and surveys, aggregation of criteria and methods, allows you to understand the needs of users better. The appropriate selection of the value of the criteria makes it possible to use the knowledge of experts to express public opinions and through in-depth communication between the recipients and decision-makers of the project process.

Therefore, the current trend of co-creating urban spatial with all stakeholders (residents or guests) opens up new possibilities for including all senses in the city design process. Therefore, the presented approach showing the potential of assessing the soundscape of spa parks from a broad perspective is necessary for the acceptance of transformed landscapes and gives new opportunities to support design decisions.

4. Conclusions

The article aimed to indicate the main criteria influencing the perception of the landscape of spa parks. The revitalization of Polish spas focuses on individual locations, and implementing one-off investments takes years. The development of spa centres in Poland is still based on the function of spa treatment, tourism and leisure, including mass recreation, which can dominate the healing processes. However, the so-called spa tourism is becoming more and more common, where the recipients of services are people who care about their well-being.

Shaping green areas is crucial in sustainable development, especially for the spa community. The current situation in the world (COVID-19 pandemic) has caused health resorts not to fulfill their existing functions, and the areas of spa parks are used, first of all, like recreational areas. Therefore, it seems crucial to develop the land to correspond to users’ current and future needs. Thus, selecting methods, classification and evaluation according to the criteria for forming existing park areas is justified.

A hierarchy of criteria for the most advantageous sound spatial in parks can be established transparently using the presented multi-criteria method of comparative analysis in decision-making. A significant advantage of this method is that the final set of criteria is not strictly defined and can be supplemented with additional essential elements.
Furthermore, assessing the consequences/effects of the choice plays a crucial role in the decision-making process. Therefore, the multi-criteria analysis method was supported by introducing weights of criteria estimated based on information entropy. Thanks to this, the impact of individual criteria on the choice of the solution option was determined. Furthermore, information entropy is a kind of measure of disorder in the system—so it corresponds to an intuitive understanding of what a friendly landscape is.

The presented multi-criteria methods of comparative analysis can support the formulation of development goals in a sustainable spatial policy regarding the perception of greenery in parks. In addition, such methods can also support the design of parks so that perception determines, for example, zones created in spa parks.

The final result of the presented multi-criteria analysis was to find the most friendly variant of the spa park, considering the designated criteria. The results presented in Table 3 show that the spa park in Wieniec Zdroj has the most favourable conditions for the landscape of the spa park (taking into account the final set of criteria).

This method, and above all, the results of analyses and guidelines for greenery design, are helpful in planning and designing specific spatial, e.g., spas. However, in addition to the Covid pandemic, which has caused a shock in the tourism sector, the more long-term challenges that we want to analyze in future research will be those related to the ecological and digital transitions, competitiveness, sustainability and resilience. Therefore, a set of criteria enabling a conscious selection of the best spatial solutions depending on many factors will be necessary.

Author Contributions: Conceptualization, M.S. (Małgorzata Sztubecka), A.M. and M.S. (Marta Skiba); Data curation, M.S. (Małgorzata Sztubecka); Formal analysis, M.S. (Małgorzata Sztubecka), A.M. and M.S. (Marta Skiba); Methodology, M.S. (Małgorzata Sztubecka), A.M. and M.S. (Marta Skiba); Visualization, M.S. (Marta Skiba); Writing—original draft, M.S. (Małgorzata Sztubecka), A.M. and M.S. (Marta Skiba). All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Data Availability Statement: Data sharing not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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