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The Impact of Developing Amenities and Corridor Infrastructure in the Borobudur Area on Landscape Visual Quality

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ABSTRACT

The Borobudur area, a priority tourism destination in Indonesia, is renowned for its rich historical and cultural significance. To enhance its appeal and improve the tourist experience, the government has been developing infrastructure and tourism amenities along the Borobudur area corridor, with significant advancements observed in the Palbapang-Borobudur corridor. This study employs the Scenic Beauty Estimation (SBE) method, a quantitative approach designed to evaluate landscape visual quality through tourists' perceptions. A survey of 60 tourists was conducted along the Palbapang-Borobudur corridor to assess the impact of these developments. The findings reveal that the development of amenities and infrastructure enhances the visual quality, particularly in the first segment at the Palbapang Lion Gate, characterized by scenic views of the Menoreh mountains and well-integrated vegetation. Landscape elements such as terraced buildings, natural vegetation, and harmonious design contribute positively to visual perception. In contrast, segments 2, 3, and 4 score lower due to mismatched building types, colors, and the presence of visually disruptive billboards. This study highlights the need for integrated planning and management to balance tourism development with the preservation of cultural and natural landscapes. The use of the SBE method provides a novel framework for assessing visual quality in heritage areas, offering valuable insights for sustainable tourism planning in similar contexts.

1. Introduction

Tourism is a vital and strategic economic sector for Indonesia. According to data from the Ministry of Tourism and Creative Economy, in 2019, the tourism sector contributed 5.8% to the national Gross Domestic Product (GDP) and employed around 13.1 million workers. Additionally, tourism plays a crucial role in preserving and promoting Indonesia's natural, cultural, and historical heritage on the global stage. As part of its efforts to develop the tourism sector, the government has established five super-priority tourist destinations: Lake Toba, Borobudur, Mandalika, Labuan Bajo, and Likupang. These destinations were selected based on their potential and readiness to become world-class tourist destinations that are competitive and sustainable.

1.1 Borobudur area

One of the super-priority tourist destinations that is the focus of this research is the Borobudur area. Located in the Kedu plains, Magelang Regency, Central Java Province, this area features Borobudur Temple as its main icon. Borobudur Temple, a UNESCO World Heritage site since 1991, is the largest and most complete Buddhist temple in the world. Built-in the 8th and 9th centuries AD by the Syailendra dynasty, the temple holds significant architectural, artistic, religious, and philosophical value. In addition to Borobudur Temple, the area boasts various other attractions, such as Mendut Temple, Pawon Temple, Ngawen Temple, Bukit Rhema Chicken Church, Pathuk Mongkrong, Camera House, and more. The region is also surrounded by stunning natural scenery, including Mount Merapi, Mount Merbabu, Mount Sindoro, and the Progo River.

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To optimize the potential of the Borobudur area as a super-priority tourist destination, the government is carrying out various developments in infrastructure and tourism amenities in this area. Tourism infrastructure includes facilities that support tourist mobility and accessibility, such as roads, airports, ports, terminals, stations, etc [1][2]. Tourism amenities include facilities that support the needs and comfort of tourists, such as accommodations, restaurants, shopping centres, recreation parks, museums, etc. Since the design of the Borobudur area as a National Tourism Strategic Area (KSPN), many things have happened that affect the sustainability of the area, such as architectural problems [3]. There have been significant changes in the Borobudur area. During the 2017-2022 period, changes in Borobudur District can be seen in the increase in residential area, with an increase of around 122.27 hectares, equivalent to around 2.14% of the previous size [4]. One important aspect of developing tourism infrastructure and amenities is the construction of gates and corridors. The gate serves as the main entrance to a tourist area, functioning as a marker, attractor, and a welcoming point for tourists. Corridors are the connecting routes between gates and tourist destinations, acting as guides, introducers, and diverters for tourists. These corridors are paths created by objects, buildings, spaces, areas, and services, and can be identified by visitors through visually connected points [5]. Gates and corridors have a significant role in shaping the character, image and identity of tourist areas, as well as influencing tourists' experiences and impressions of the area.

Considering the size of the Borobudur Temple area based on the zoning by JICA in 1979, this research is limited to the Palbapang-Borobudur corridor. Previous studies often focus on the socio-economic or cultural impacts of tourism development [6] but rarely explore the visual impact on the landscape quality using quantitative approaches. This research fills that gap by employing the Scenic Beauty Estimation method to assess the visual changes caused by the development of amenities and infrastructure in the Palbapang-Borobudur corridor. The Palbapang-Borobudur corridor, designated as SP-1 (Preservation Sub-Area-1), is the main area for preserving world heritage sites. It includes Borobudur Village and Wanurejo Village in Borobudur District, as well as Mendut Village, part of Ngrajek Village, part of Pabelan Village, part of Paremono Village, and part of Bojong Village in Mungkid District.

The selection of research locations is based on the following criteria:

1. Significant variations to be identified in the Borobudur area corridor.
2. Areas that represent the corridor, including various types of environments and tourism activities.
3. Corridor development, facilities and infrastructure, tourism activities, and environmental aspects.
4. Representation of the start, middle, and end points of the corridor to provide a comprehensive picture.

The selection of the Palbapang-Borobudur corridor as a research location was also informed by comparisons with the other three corridors. The Blondo-Borobudur corridor, located in Mungkid District, serves as the central government area of Magelang Regency, where facilities are primarily dominated by government offices' needs. On the other hand, the Klangon-Borobudur corridor has started developing tourism facilities, but it lags behind Palbapang-Borobudur in terms of the number of buildings, with only 5,909 buildings covering an area of 59.58 hectares, as shown in Figure 1. Lastly, the Salaman-Borobudur corridor remains largely green, with tourism activities concentrated around the Kembanglimus Gate and the Kembanglimus Balkondes, and a limited variety of tourism facilities.

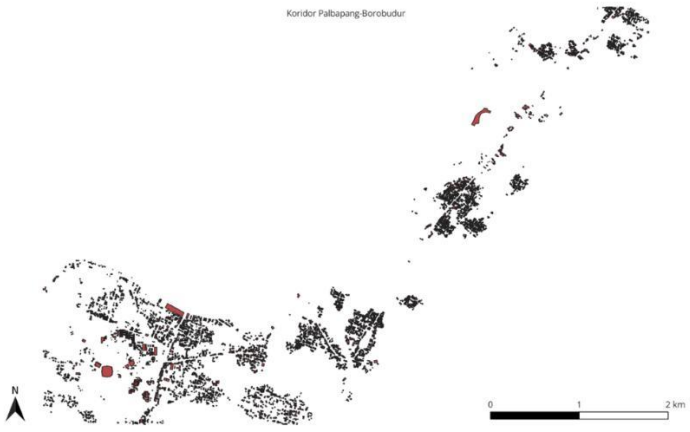

Figure 1. Ground map of the Palbapang-Borobudu corridor

These criteria are reinforced by SP-1 for the Borobudur Area in Figure 2 as regulated in Presidential Regulation Number 58 of 2014 concerning the Spatial Plan for the Borobudur Area. According to Presidential Regulation no. 58 of 2014 concerning Spatial Planning of the Borobudur Area, Borobudur Conservation Sub-Area 1 (SP-1) covers the area around Borobudur Temple and along the Palbapang-Borobudur corridor [7][8]. Based on information from Service Memorandum No. 330/ND/CK/2022, the area boundaries include main road corridors such as Mayor Kusen, Sudirman, Balaputradewa, and Pramudyawardhani [9]. SP-1 or Conservation Sub-Area 1 in the Borobudur area refers to the zone designated for the protection and prevention of damage to the physical environment of archaeological monuments [10]. Therefore, a visual study of the landscape in the Palbapang-Borobudur corridor is considered important, especially in relation to the development of amenities and infrastructure. The development of amenities and infrastructure has a direct impact on the condition of the visual landscape.

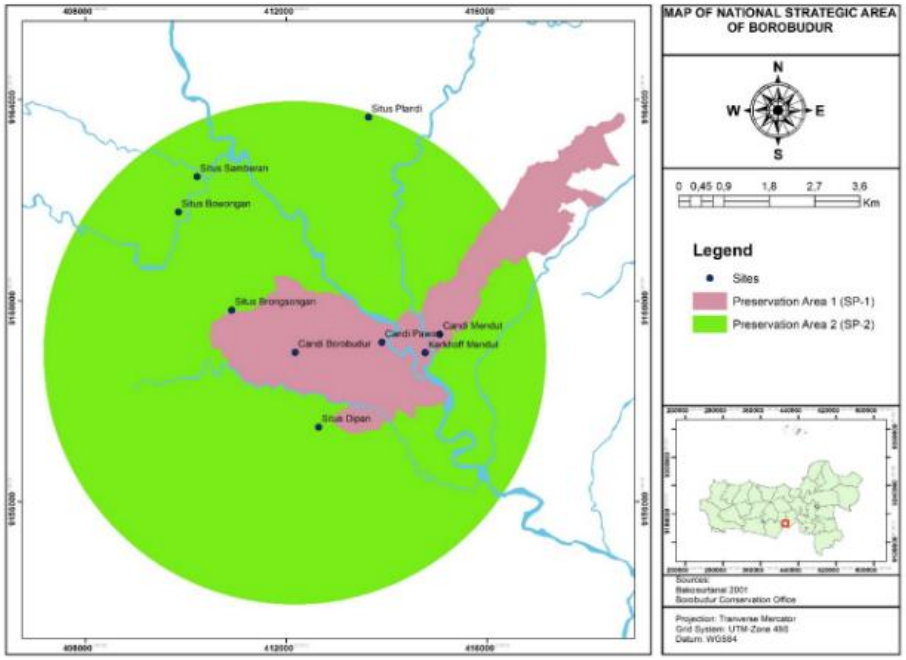

Figure 2. KSN Borobudur SP-1 and SP-2 [7]

By focusing on the visual quality of the Palbapang-Borobudur corridor, this study highlights the critical balance between preserving natural and cultural heritage and meeting the growing demands of tourism infrastructure. The findings provide actionable insights for sustainable tourism planning. Based on the development of tourism infrastructure and amenities in the Borobudur area corridor, the hypothesis of this research posits that enhancing these facilities will substantially enhance the visual quality of the landscape. It is anticipated that through integrated planning, this enhancement will not only elevate the tourist experience but also ensure the harmonious coexistence of tourism development with the preservation of the cultural landscape.

1.2 Landscape Visual Elements View

The view is becoming a main reason for choosing the property. However, the views are often not fully utilized [11]. The vista can present itself as an ever-evolving panorama, incorporating diverse elements that harmonize with one another, as depicted in Figure 3. Moreover, the vista serves as the boundary of visual space within a location, making it an alluring backdrop for architectural features.

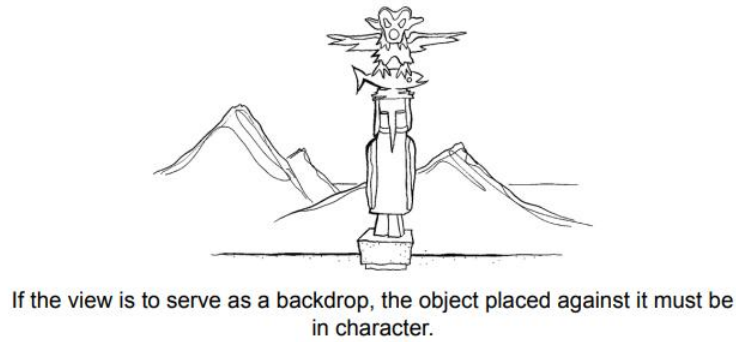

Figure 3. Scenery as background [11]

1.2.1 Vista

Vista is a well-planned view or scene, where there is a vantage point provided to see the object in focus [11], with the earth element between the two becoming part of the visual experience. An example of a viewing vista is shown in Figure 4. Usually, vistas are created to provide a dramatic or impressive visual experience on a particular viewing objective. A vista is a visual element within the landscape that plays a crucial role in discussions of coherence and harmony. The presence of a vista within related areas must align harmoniously. For instance, if a vista is intended as an extension of a particular area or space, the relationship between its character and scale becomes paramount. A vista belonging to a space with a luxurious atmosphere should culminate in a view that is equally impressive and conservative. In the context of this research, vista refers to observation points from which observations are made.

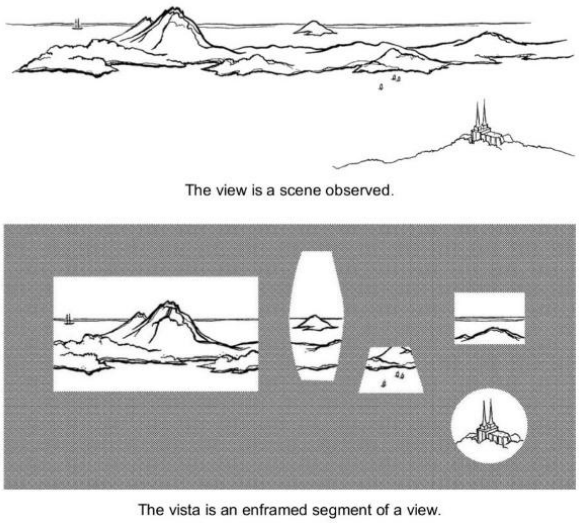

Figure 4. Vista is a view that has been framed at a viewing point [11]

1.2.2. Axis

An axis is a linear element that connects two or more points in a landscape design. Therefore, the axis is a connection element that unites various parts in a landscape design. The axis has several characteristics as illustrated in Figure 5:

1. It is directional, indicating an orientation,
2. Is regular, carries a certain order and layout,
3. Is dominant, has a strong influence on design,
4. Monotonous, it is considered to convey an impression with little variation [11].

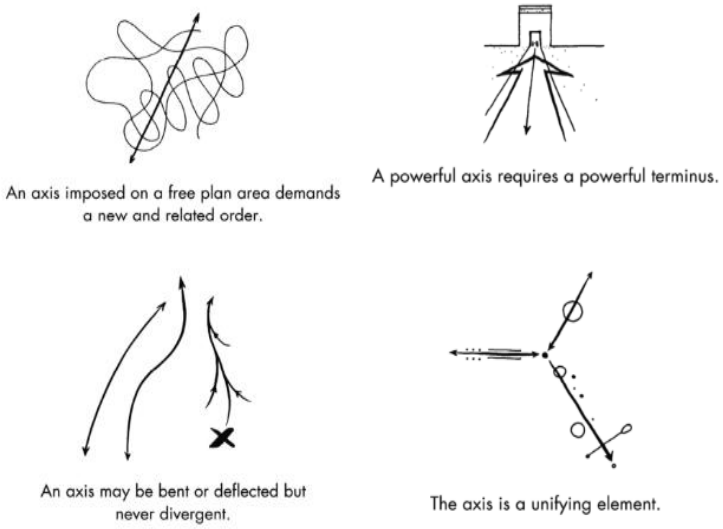

Figure 5. Axis characteristics (axis) [11]

The landscape is divided into six elements that are closely related one another, namely topography, vegetation, buildings, land structure (site structure), roads (pavement) and water [12]. All of these elements depend on each other and influence the location, degree of enclosure, and atmosphere of the space. Landscape quality can be defined as natural characteristics that are variously influenced by human activities such as noise, pollution and development [13]. View quality or visual landscape focuses attention on the visual features of the landscape, such as the harmony of form, colour, and public perception of the landscape [14]. Therefore, tourism amenities and infrastructure will be the focus of the visual landscape study in this research. The findings of this study not only contribute to enhancing the tourist experience in the Borobudur area but also serve as a valuable reference for planning and managing other priority tourism destinations in Indonesia. The approach can be adapted to assess and mitigate the visual impacts of tourism development while preserving the cultural and natural integrity of other regions.

2. Research Methods

2.1 Scenic Beauty Estimation

This research employs the Scenic Beauty Estimation method to assess the scenic beauty of the landscape. Scenic beauty is quantitatively measured using a model that evaluates the overall quality of a landscape [14][15]. This assessment considers the combined impact of various physical features visible within the landscape [17]. The Scenic Beauty Estimation Model incorporates criteria and perceptions of beauty, evaluating various landscape elements to assess the visual quality of the Palbapang-Borobudur corridor. Natural and cultural elements play crucial roles in determining landscape quality, particularly in supporting the rural characteristics of the Borobudur area. The sustainability of green areas, predominantly rice fields, is considered pivotal in enhancing visual quality. Additionally, settlements situated on slopes and surrounding villages that harmonize with nature contribute positively to the overall visual aesthetics [18]. Therefore, assessing the visual quality of a landscape is important to identify landscape elements that have a significant impact on beauty.

Criterion values are brought by the observer to the assessment situation and are an important component in evaluative judgments. In more complex assessment situations, observers may have to assign multiple criteria values to make different evaluative judgments. For example, in assessing the beauty of a forest, observers may have different criteria based on their past experiences with the forest. In addition, the surrounding context in which the observer evaluates the scene can also influence the criteria applied. Scenic Beauty Estimation is able to produce beauty estimates that are independent of the assessment criteria of each observer.

This method consists of a number of stages which are detailed as follows: First, the initial step involves determining the concept to be implemented. Second, determining the vantage point or optimal viewing position for taking photos. Third, continue with the shooting process in accordance with the established concept. Fourth, select representative photos from the results of the photo shoot. Fifth, to ensure representativeness, check the results by the respondents involved. Sixth, this method involves testing Scenic Beauty Estimation (SBE) to evaluate the level of beauty of the scenery captured in the photos. Finally, the seventh step involves the interpretation and preparation of recommendations based on the results obtained from this method. The Scenic Beauty Estimation formula is as follows:

$$SBEx = (Zyx – Zyo) \times 100 \quad (1)$$

Explanation:
SBEx = Estimated scenic beauty value (SBE) of the xth landscape
Zyx = Average z value of the xth landscape
Zyo = Average value of a particular landscape as a standard

The weakness of the Scenic Beauty Estimation method is in its ability to measure the visual quality of the landscape objectively because it depends on individual perceptions and preferences [19]. In addition, this method cannot consider non-visual factors that also influence landscape assessment, such as sound, aroma, climate, culture, history, etc.

2.2 Survey Methods and Respondent Selection Criteria

The surveys use questionnaires, with population referring to the group of people or entities as the focus of the research [20]. Because populations are often large, researchers cannot access all individuals in the population. Instead, researchers select a sample, which is a group of individuals drawn from a larger population, to represent the general characteristics of that population. Research was conducted on this sample, and the results are expected to be generalized back to the entire population.

In this study, 60 respondents were included, which exceeds the minimum number required for questionnaire testing. The goal was to ensure the data obtained are highly representative. Respondents were selected based on their presence in the Palbapang-Borobudur corridor of the Borobudur area, aged at least 18 years, and considering their regional origin. There are 50 evenly distributed vantage points across 5 segments. Questionnaires were distributed at Mendhut Taman Sari restaurant in Mendut and Lepen Shumong Village, Ngrajek Village. The respondents were instructed on how to complete the questionnaire using a rating scale.

In the Borobudur area context, the assessment of landscape quality includes evaluating visual elements interacting with observers. For instance, the foreground in the Borobudur area corridor refers to the closest visible area, while the background encompasses elements such as mountains or other visible features surrounding the Borobudur area [21]. Therefore, it is important to ensure that the shooting point (vantage point or vista) is not obstructed by positioning it at eye level.

3. Results and Discussion

3.1 Mapping Landscape Elements & Tourism Amenities

As the main access route to Borobudur Temple, the Palbapang Corridor is transforming to improve the quality of life of residents. This transformation involves converting housing along the corridor into tourist accommodation (homestays) and encouraging the development of businesses such as restaurants.

This section explores the findings of research studies that use the Scenic Beauty Estimation (SBE) method to evaluate landscapes. Building and Environmental Planning (RTBL) Document, which provides clear and comprehensive guidelines regarding spatial and aesthetic management in the area Borobudur, serves as a valuable resource for setting landscape standards.

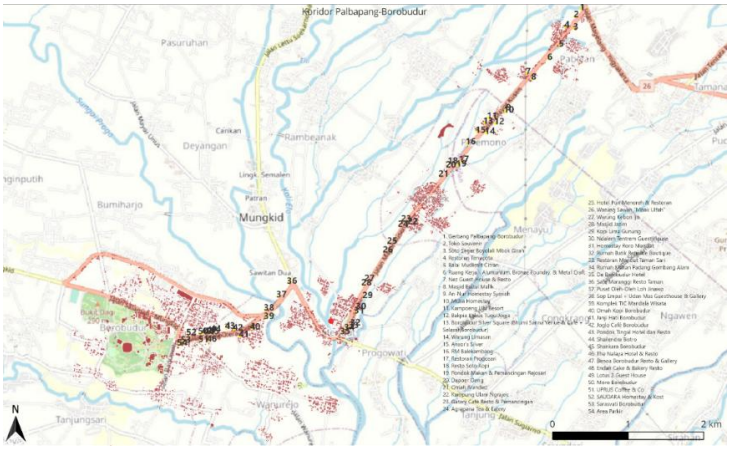

Figure 6. Mapping of Tourism Amenities in the corridor

The Palbapang Corridor serves as the main entrance to Borobudur Temple, thereby playing a significant role in the area's development. The improvement in the quality of local homes is achieved through their conversion into tourist cottages (homestays), simultaneously promoting business ventures such as restaurants. According to the mapping shown in Figure 6, there are 53 identified amenity points, including 7 souvenir shops, 27 restaurants and cafés, 2 houses of worship, 8 accommodation amenities, 4 combined accommodation-restaurant amenities, 1 restaurant-souvenir shop-venue, 1 tourist information center, and 1 tourist travel agent. The Palbapang-Borobudur corridor crosses five villages and one sub-district: Paremono Village, Pabelan Village, Ngrajek Village, Mendut Village, Wanurejo Village, and Borobudur Village. Data collection began with segmenting the corridor to define regional boundaries, as illustrated in Figure 7. Important considerations included the presence of water bodies, national road borders, and village and sub-district boundaries along the corridor. Landscape elements such as the Elo River and the Progo River were found in Mendut Village. In contrast, Pabelan, Ngrajek, and Paremono villages featured smaller rivers, rice field irrigation, and drainage systems. The Palbapang-Borobudur corridor is intersected by the National Road, divided into Jalan Mayor Kusen, Jalan Sudirman, and Jalan Balaputradewa. Jalan Mayor Kusen crosses through three villages and one sub-district: Paremono, Pabelan, Ngrajek, and Mendut.

Borobudur and Pabelan Villages show high population densities, indicating more intensive human activity, which impacts spatial planning and environmental aesthetics. High population densities in Borobudur, Mendut, and Pabelan Villages may necessitate better urban planning to balance population growth with environmental sustainability. Variations in population density between villages and sub-districts reflect differences in human activity levels and their effects on the landscape's visual quality. Villages with lower population densities may retain more natural elements and visually appealing landscape features.

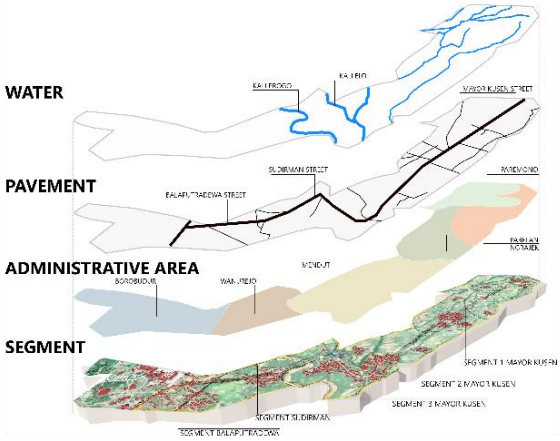

Figure 7. Overlay mapping of landscape elements (water and roads) and village- boundaries

After the data collection on landscape elements and administrative boundaries has been completed. The distribution of vantage points is divided into five segments based on roads and regional boundaries between villages. This segment division also serves to compare the results of landscape assessments and formulate factors that influence the visual condition of the landscape. Corridor segment 1 (Paremono Village and Pabelan Village), segment 2 (Ngrajek Village), and segment 3 are on Jalan Mayor Kusen (Mendhut Village). Meanwhile, segment 4 crosses Jalan Sudirman and Segment 5 is on Balaputradewa Street.

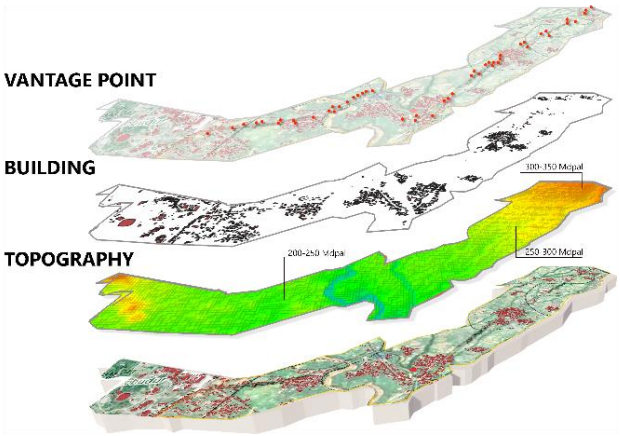

Figure 8. Overlay of density and topography mapping of the Palbapang-Borobudur corridor

Building density data was collected for each segment, with topography considered as a key landscape element, as illustrated in Figure 8. Segment 1 of Jalan Mayor Kusen features relatively high topographic conditions, ranging from 300-350 meters above ground level and 250-300 meters above ground level. In contrast, segments 2 and 3 of Jalan Mayor Kusen, as well as the Sudirman and Balaputradewa segments, have lower topography, between 200-250 meters above ground level.

Building density was observed in segments 2 and 3 of Mayor Kusen, the Sudirman segment, and the Balaputradewa segment. However, the distribution of buildings is uneven and tends to be concentrated in specific areas. To address this, vantage points were evenly distributed to represent both dense and non-dense areas while maintaining a focus on amenities and tourism-supporting infrastructure.

3.2 Scenic Beauty Estimation Analysis

This study surveyed 60 tourists (56.9% men and 43.1% women). Age-wise, the majority of tourists (48.3%) were between 18 and 25 years old. The 26-35 age group was also significant, making up 28.3% of the respondents. Tourists aged 36-45 accounted for 11.7%, those aged 46-55 were 5%, and tourists aged 56-65 constituted 6.7%. When considering education levels, the majority of tourists (55%) had attained a Bachelor's degree. Those with a Master's degree made up 20%. Tourists with a Secondary education comprised 21.7%, and those with a Diploma 3 (D3) made up 3.3%. In terms of occupation, students represented the largest group at 25%. They were followed by private employees (23.3%), teachers (21.7%), and entrepreneurs (11.7%). Housewives accounted for 10%, lecturers for 3.3%, and videographers for 1.7%. This data indicates that tourism appeals to a wide range of individuals, from students to professionals. The predominance of students can be attributed to their more flexible schedules compared to other professions. Geographically, the majority of the tourist sample came from Central Java, with 48.3% hailing from Semarang. Other significant contributions came from Klaten (5%), Brebes (3.3%), and Salatiga (1.7%). Additionally, there was a notable number of tourists from Jakarta, comprising 3.3% of the sample. Outside Java, tourists come from Lampung (3.3%), Jayapura (1.7%), and Samarinda (1.7%). From abroad, there are tourists from Singapore (5%).

Figure 9 shows the distribution of vantage points (vistas) that will be assessed by each tourist. Based on the SBE (Scenic Beauty Estimation) method [17] does not have specific regulations regarding taking vantage points for visual landscape observation points. However, there are general guidelines used to ensure that the data used is accurate and reliable. The following are general guidelines that are used as a reference:

Visibility

Vantage point (observation point) must be selected in a location that has good visibility of the landscape to be assessed. This means that the viewing point must be free from obstacles such as trees, buildings, or other structures that could obstruct the view.

Security

Vantage point (observation point) must be selected in a safe and easily accessible location. This is important to ensure that observers do not endanger themselves when capturing data.

Vantage point (observation point) should be chosen at a location that is representative of the scene as a whole. This means that the vantage point should not be biased towards any particular area of the landscape

Representation

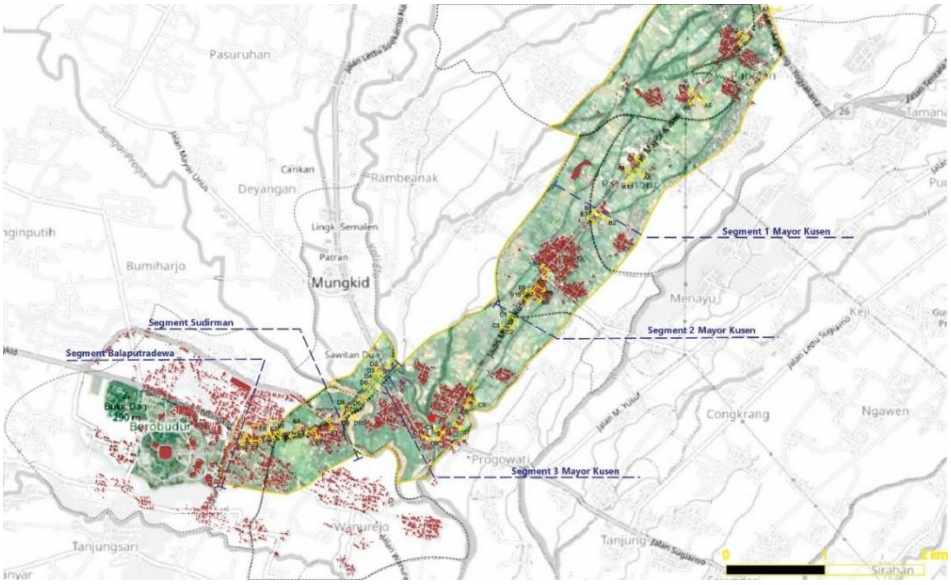

Figure 9. Mapping vantage points and Palbapang-Borobudur corridor segments

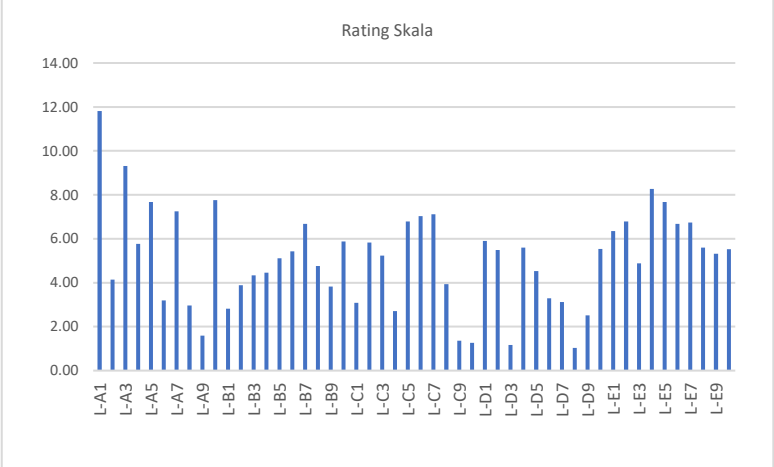

Figure 10. Rating scale results from a questionnaire survey of 60 tourists

Based on the graph of the scale rating results in Figure 10, it is evident that the landscape with code A1 possesses the highest visual quality score of 11.82, indicating it is attractive to tourists. This landscape is situated in Segment 1 of Mayor Sills. Conversely, the landscape with code D8 has the lowest visual quality score of 1.04, suggesting it is less appealing to tourists. This landscape is located in the Sudirman Segment. The Balaputradewa segment also boasts relatively high visual quality scores. Six vantage points in this segment have high visual quality values, three vantage points score medium, and one image scores low. This distribution can be observed in Figure 11, which shows the ratings spread across Segment 5, indicating an overall average assessment score.

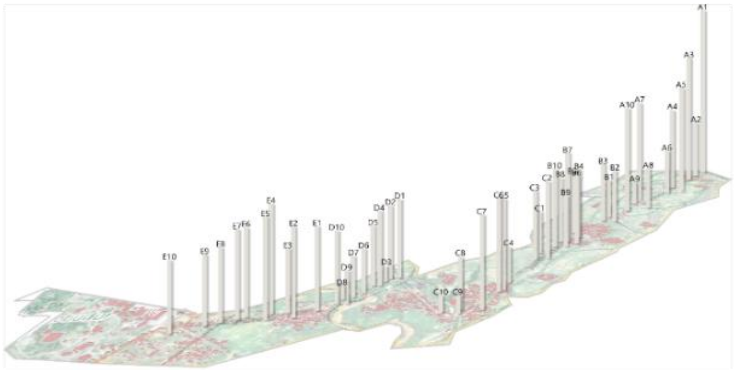

Figure 11. Mapping scale ratings in the Palbapang-Borobudur corridor

Among the amenities, the highest visual quality score is 8.26, attributed to the Pondok Tingal hotel and restaurant, coded E4. In contrast, the lowest score is associated with the Balaputradewa road corridor leading to Borobudur Temple. Segment 1, Mayor Kusen, has the highest average landscape visual quality value at 6.234, while the Sudirman Segment has the lowest average at 4.143. This demonstrates a significant difference in the visual quality of the landscapes between these segments. The Scenic Beauty Estimation results identified a standard landscape at point C5. The selection of standard landscapes is based on criteria outlined in the Borobudur RTBL document, which includes the following criteria [9]:

1. Has front, back and side yards,
2. traditional facade,
3. Using hedges, and
4. Traditional roofs such as joglo, limasan, and kampung.

Based on the Scenic Beauty Estimation value by subtracting the value from the standard landscape. So positive SBE values are obtained at points A1, A3, A5, A7, A10, C6, C7, E4, and E5.

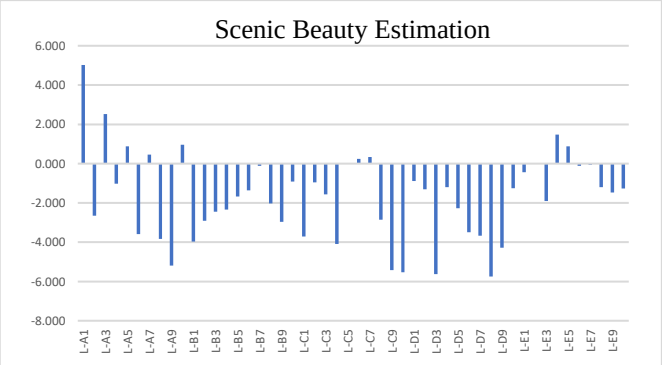

Figure 11. Scenic Beauty Estimation on the Palbapang-Borobudur corridor

In Figure 12, the standard landscape at point C5 is assessed as meeting the predetermined criteria so that the result is 0. The results of the scale rating are then compared with the predetermined standard landscape. Points that have a positive SBE value indicate that the landscape at these points is rated as more beautiful than the standard landscape that has been set, while other points have a negative score, indicating that the landscape at these points is rated as less beautiful than the standard landscape. Based on the Scenic Beauty Estimation value by subtracting the value from the standard landscape. So positive SBE values are obtained at points A1, A3, A5, A7, A10, C6, C7, E4, and E5 which can be seen in Figure 13.

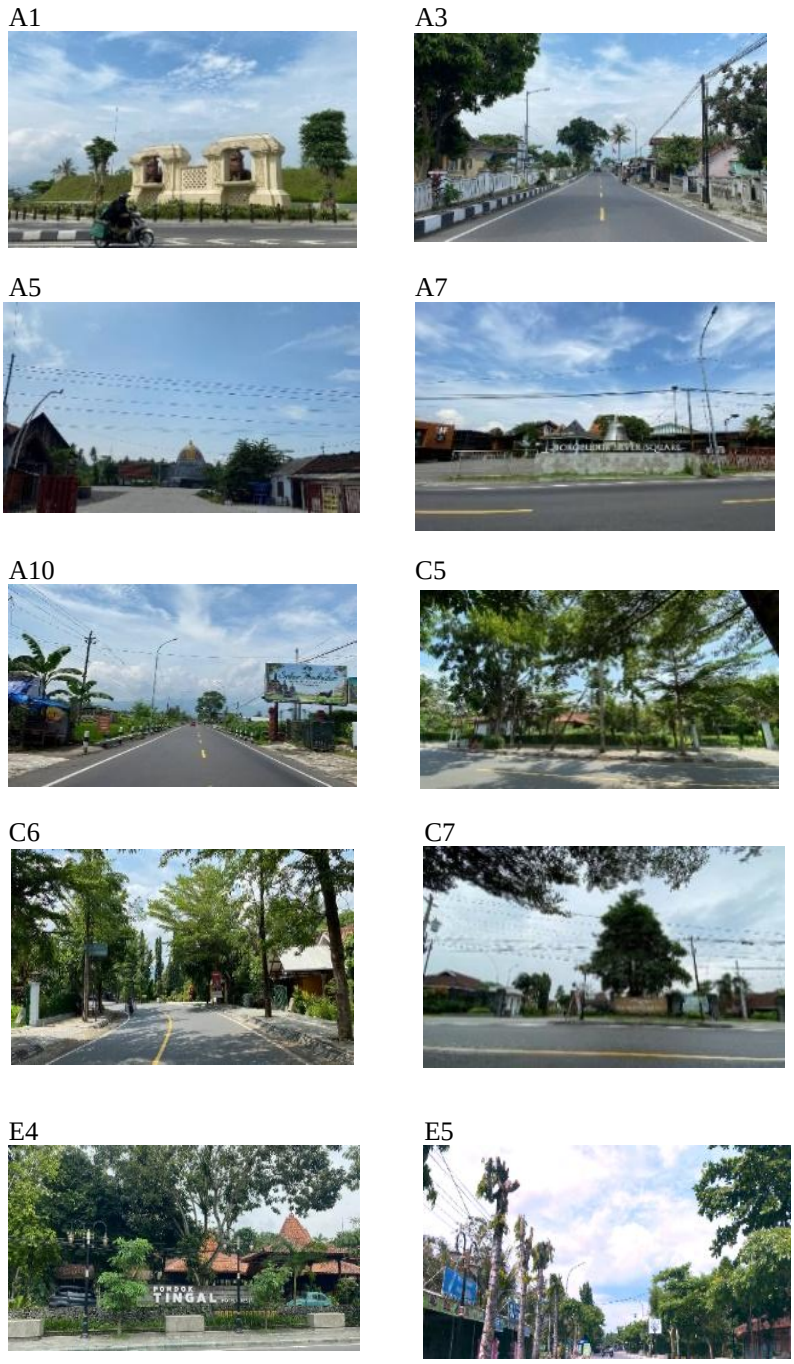

Figure 13. Positive SBE results

Positive SBE results tend to be obtained from 5 amenities with neutral building color shades and traditional roofs (*joglo*, *limasan*, and *kampung*). Meanwhile, positive SBE results in corridors tend to be characterized by symmetry between building proportions and vegetation. Apart from that, the presence of incised mountains has a significant effect as the background of a corridor.

3.3 The impact of the development of tourism amenities and infrastructure on the visual condition of the landscape

Topographic landscape elements have a significant influence on the visual condition of the landscape. The view of the Menoreh mountains is often mentioned together with high visual value,

indicating that the presence of mountain views can improve the visual quality of the landscape. Vegetation as a landscape element such as coconut trees, rambutan trees, pula trees, bushes and rice fields contribute to high visual value. However, not all vegetation has a strong influence, depending on its type and arrangement in the landscape.

The building elements rely on the characteristic neutral wall colors and tropical roofs seen in buildings in areas of high visual value. Meanwhile, the presence of advertising tends to be associated with a decrease in visual value to medium or low. Buildings with striking colors such as orange also reduce the visual value to medium or low. Roads (pavements) are presented in each segment in the form of roads and pedestrians (there is street furniture as well as street lights and chairs). The road component does not show a strong correlation with the visual value of the landscape and tends to be neutral.

The presence of land structure elements, one of which is terraces, often appears in descriptions of segments with high visual value, indicating that a well-organized land structure can contribute to increasing visual value. The water element is present in the form of drainage, rice field irrigation, the Progo river, and the Elo river is only mentioned in a few segments and does not show a clear correlation with the visual value of the landscape

Table 1. Landscape Characteristics based on scale rating

Category	Mark	Photo	Amount	Characteristics
Tall	5.90-11.82	A1, A3, A5, A7, A10, B7, C5, C6, C7, D1, E1, E2, E4, E5, E6, E7	16	- There are incised mountains in the background - The vegetation is arranged quite harmoniously with the condition of the building - There is a terrace - The existence of rice fields - Buildings with neutral colors
Currently	4.14-5.88	A2, A4, B3, B4, B5, B6, B8, B10, C2, C3, D2, D4, D5, D10, E3, E8, E9, E10	18	- The background is in the form of vegetation elements - There is a terrace - Buildings with neutral colors with medium-low scores tend to have signboards - The vegetation is arranged quite harmoniously - The existence of rice fields
Low	1.04-3.94	A6, A8, A9, B1, B2, B9, C1, C4, C8, C9, C10, D3, D6, D7, D8, D9	16	- Irregular vegetation (vegetation only as a background for the building) - There is a striking color (orange) on the building - There are advertisements and signboards on the building

Based on Table 1, landscape assessment categories are presented according to the scale rating values derived from photo evaluations at vantage points. Each category encompasses specific characteristics observed in the landscape. A total of 50 photos were ranked from 1 to 50 and divided into three quartiles, resulting in three groups: high, medium, and low.

The high category, with a value range of 5.90-11.82, includes 16 vantage points. This category features characteristics such as a clearly visible mountain background, harmoniously arranged vegetation, terraces at the front of buildings, and the use of neutral building colors. The medium category, with a value range of 4.14-5.88, comprises 18 vantage

points. This group is characterized by backgrounds with landscape elements like vegetation, buildings using materials in neutral colors, presence of signboards or advertisements on buildings, rice field areas, and vegetation that is reasonably harmonized with the surrounding environment.

The low category, with values ranging from 1.04 to 3.94, consists of 16 vantage points. Characteristics of this category include irregular vegetation, some buildings lacking vegetation (serving only as a background), absence of terraces, use of striking colors on buildings (such as orange), and presence of signboards and advertisements on buildings. Overall, the data grouping indicates that the development of amenities and tourism infrastructure in the Palbapang-Borobudur corridor positively impacts the visual quality of the landscape. However, certain areas still require improvement.

The high-score group is predominantly composed of landscape Segment 1 (marked with code A) with five points, and Segment 5 (marked with code E) with six points. Hence, the development of amenities and infrastructure in Segments 1 and 5 is considered to have a positive impact on the visual quality of the landscape. In Segment 2 (marked with code B), the development of amenities and infrastructure has not yielded significant results. The presence of advertisements is seen as a factor reducing the visual quality of the landscape. Segments 3 (marked with code C) and 4 (marked with code D) have lower visual landscape assessment scores compared to the other three segments. The presence of advertisements and signboards, along with the use of striking building colors like orange, are factors that contribute to the reduced visual quality of these landscapes.

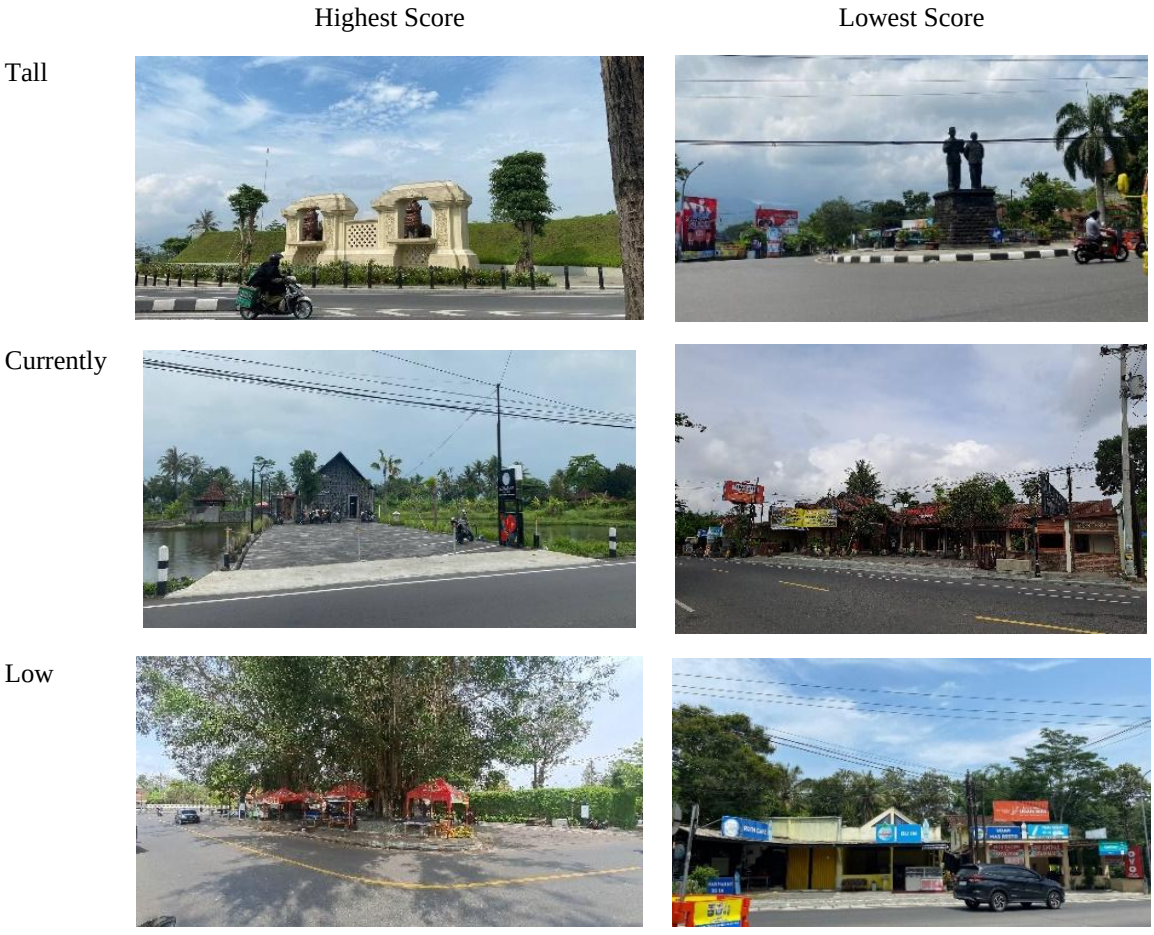

Figure 14. Vantage points based on high, medium and low scores

From the analysis in Figure 14 it can be concluded that topography which includes mountain views and a harmonious arrangement of vegetation has a positive influence on visual value. This is also supported by the argument in a paper entitled Large-Area Empirically Based Visual Landscape Quality Assessment for Spatial Planning—A Validation Approach by Method Triangulation that assessing the visual quality of landscapes and natural elements makes a positive contribution to the beauty of the landscape [22]. Nature is also capable of providing many aesthetic experiences [23]. Therefore, natural scenery in the form of vegetation, rice fields and incised mountains have a significant impact on the visual condition of the landscape.

Building elements also have a significant contribution in assessing the landscape quality of tourism amenity buildings. This is supported by research entitled Using Composition to Assess and Enhance Visual Values in Landscapes which argues that built heritage shows that the presence of historic buildings and traditional architecture contributes significantly to the aesthetic value of a landscape [24]. Landscapes with traditional architectural buildings such as village roofs, pyramids and joglos tend to produce high visual landscape value. This is also supported by walls made from natural materials (stone and wood) and a neutral color palette. However, the desire to build tourism facilities can reduce natural areas and cause a decrease in the visual quality of the landscape [25]. In the case of the Palbapang-Borobudur corridor, it can be seen in Figure 15 and Figure 16. that the presence of advertising on buildings and land structures that are less organized has a negative assessment. It is important to respect the social and cultural authenticity of communities [26], and preserve their cultural heritage and traditional values. In this way, we can ensure that tourism development does not damage the cultural and social elements of the tourism landscape [27][28]. Based on the analysis, further control is needed for development policies so that landscape aesthetics are well maintained.

Meanwhile, the presence of road and water elements has a more neutral or less significant influence on the visual condition of the landscape. This argument is supported by the existence of roads and water that are evenly distributed in each segment. However, based on the SBE results, the results were evenly distributed, with high, medium and low scores.

Based on observations regarding the extent to which the development of amenities and infrastructure affects the visual condition of the landscape. There will be construction of gates and corridors in 2020. Therefore there will be changes to the shape of the Palbapang Borobudur gate as follows:

Figure 15. Comparison of Palbapang gate development in 2019

Figure 16. Comparison of Palbapang gate development in 2024

Based on the results of the Scenic Beauty Estimation, the Palbapang gate in its current condition received the highest positive score. Prior to the arrangement of the Palbapang gate area, there were numerous advertisements and an arc-shaped gate, which obstructed the view of the Menoreh mountains. The current gate structure, however, lacks an arch, with buildings situated only on the left and right sides of the road. Additionally, the area is now free from electricity poles and advertisements. The Mayor Kusen corridor road has been widened, enhancing the visibility of the incised mountains and positively impacting the visual condition of the landscape. This is supported by a journal entitled Assessing Visual Quality of Landscape on Roadside Greenery in Yogyakarta City, Indonesia. Landscape improvements may include increasing complexity by

diversifying tree species, enhancing coherence by integrating landscape features (plants, buildings, and roads), improving stewardship by better maintenance of roadside vegetation, and promoting naturalness by ensuring the natural shapes and distribution of trees within their local environment [29]. These efforts contribute to a more harmonious and visually appealing roadside landscape, ultimately aligning with broader goals of sustainable urban design and tourism development.

Figure 17. Comparison of corridor development on Jl. Mayor Sills in 2019

Figure 18. Comparison of corridor development on Jl. Mayor Sills in 2024

This improvement also affects the Mayor Kusen corridor in Segment 1 (Pabelan and Paremono Subdistricts), as shown in Figure 17 and Figure 18. By 2020, the road was widened, and vegetation was arranged along the route. In contrast to 2019, when there was shade vegetation on the Mayor Kusen road section, the left and right sides of the road in 2024 no longer have such vegetation. This alteration provides a broader view of the incised mountains. Thus, infrastructure developments, including road widening and vegetation arrangement, have significantly impacted the visual quality of the landscape.

Notable findings indicate that landscapes with distinct and consistent characteristics, a harmonious integration of hardscape elements and vegetation, and the inclusion of green open spaces or clear blue skies are highly preferred. These elements collectively contribute to the aesthetic appeal of the corridor. This is in line with findings at research focus locations elsewhere entitled "Assessing scenic beauty of culture-based landscapes in North Toraja Regency"[30].

Therefore, tourism management strategies must consider preserving and enhancing the unique landscape character when developing tourist facilities and attractions. This approach ensures that improvements align with visual harmony and elevate the overall landscape quality, offering an enhanced experience for visitors.

Figure 19. Comparison of corridor development on Mayor Sills in 2019

Figure 20. Comparison of corridor development on Mayor Sills in 2024

In Figure 19 and Figure 20, the presence of pedestrians has no effect on the visual condition of the landscape based on previous analysis. This is further supported by the condition of the Mayor Kusen corridor in Segment 1 (Pabelan and Paremono Subdistricts). There have been no significant changes from 2019 to 2024, with alterations only occurring in the color of the buildings to the left of the corridor (from the Palbapang-Borobudur direction). Based on the results of the Scenic Beauty Estimation, this corridor segment received a high score with positive implications. This positive evaluation is attributed to the presence of vegetation that is not overly dense, allowing clear views of the Menoreh mountains.

4. Conclusion

The research results indicate that the development of tourism amenities and infrastructure has a significant impact on Segment 1, particularly due to changes in the shape of the gate and the arrangement of vegetation. Topography plays a crucial role in assessing the visual quality of the landscape using the Scenic Beauty Estimation method. Segment 1, which offers views of the Menoreh mountains, received a high visual score. Vegetation contributes positively to the visual assessment, while the shape, color, and design of buildings also influence the perception of the landscape. Land structure significantly impacts visual quality, with buildings featuring terraces scoring higher than those without.

The segments 2, 3, and 4 tend to have medium and low scores. This is because several amenities and tourism infrastructure in these segments have building types and colors that do not match the surrounding environment. The use of visually distracting signboards and advertisements also contributes to lower scores. This issue is exacerbated by the growth of new amenities aligned with infrastructure development in 2020.
However, the presence of natural components such as water does not significantly influence visual assessment. Segment 1 scores high despite only having water elements like irrigation, rice fields, and drainage. In Segment 5, there are few landscape elements involving water. Conversely, Segments 3 and 4, which include Kali Elo and Sungai Progo, have lower average scores. This may be because the presence of water is not visible when tourists cross the corridor due to the height of the bridges over the water surfaces.

In the segment 1, the development of amenities and infrastructure significantly enhances the visual quality of the landscape, mainly due to the arranged view of the Menoreh mountains. Meanwhile, in Segments 2, 3, and 4, infrastructure development and amenities do not have a significant impact because they are not accompanied by building character planning. For instance, many buildings still use signboards and advertisements with striking colors. In Segment 5, infrastructure development and improvements in amenities have not been extensive from 2019 to 2024.

In conclusion, maintaining natural landscape elements during the development of tourism infrastructure and amenities is crucial. Natural elements such as vegetation and views of the Menoreh mountains can enhance the visual quality of the landscape. Additionally, preserving traditional elements and using natural building colors can improve visual assessment scores. The presence of terraces and the arrangement of vegetation in building yards also significantly impacts the visual quality of the landscape.

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