World Journal of Advanced Research and Reviews
eISSN: 2581-9615 CODEN (USA): WJARAI
Cross Ref DOI: 10.30574/wjarr
Journal homepage: https://wjarr.com/

(RESEARCH ARTICLE)

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Visual quality evaluation of the landscape along the Soekarno-Hatta road green corridor in Palembang using the scenic beauty estimation and semantic differential methods

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World Journal of Advanced Research and Reviews, 2026, 31(01), 1120–1128

Publication history: Received on 09 June 2026; revised on 15 July 2026; accepted on 18 July 2026

Article DOI: https://doi.org/10.30574/wjarr.2026.31.1.1920

Abstract

Green belts on medians and traffic islands play a crucial role in shaping the visual quality of urban road corridors. This study aims to evaluate the visual quality of road green spaces along Soekarno-Hatta Street in Palembang based on respondents' preferences and perceptions, and to formulate improvement recommendations. The study employed a quantitative descriptive method through field observations, photographic documentation, and questionnaires distributed to 50 respondents. Visual assessments were conducted on 40 landscape photographs taken from 10 vantage points, with four viewing directions at each point. Data were analyzed using the Scenic Beauty Estimation (SBE) method to measure visual beauty preferences and the Semantic Differential (SD) method to assess landscape visual characters based on 14 pairs of bipolar adjectives. The results showed that based on the SBE method, 13 landscapes were categorized as high, 21 as moderate, and 6 as low, with the highest score in L1 (138.70) and the lowest in L37 (−152.16). Meanwhile, the SD method classified 13 landscapes as high, 13 as medium, and 14 as low, with the highest mean values in L15 and L40 (4.58) and the lowest in L37 (2.55). In conclusion, the visual quality of green belts is heavily influenced by vegetation arrangement regularity, maintenance neatness, plant composition, and surrounding visual elements. Formulated recommendations include implementing routine vegetation maintenance, arranging more orderly planting patterns, adding and replacing plants, and controlling disturbing visual elements to enhance the aesthetic value of the road corridor.

Keywords: Green belts; Visual quality; Road medians; Traffic islands; Urban landscape; Soekarno-Hatta Road

1. Introduction

The city of Palembang is experiencing continuous annual growth in infrastructure, built-up areas, transportation activity, and population. These dynamics are putting pressure on Green Open Spaces (GOS), particularly in areas with high traffic intensity. However, GOS serve important physical, ecological, sociocultural, and aesthetic functions for the quality of the urban environment, including the requirement to provide at least 30% of the city's total area as GOS, as stipulated in Regulation of the Minister of Agrarian Affairs and Spatial Planning/Head of the National Land Agency No. 14 of 2022. Vegetation elements in GOS play an aesthetic role in shaping the visual quality of an area through leaf color, canopy shape, plant texture, uniformity of planting patterns, and visual rhythm (Bahri et al., 2019). Along roadways, green open spaces consist of roadside strips, road medians, and traffic islands. Road medians separate opposing traffic flows and provide a more orderly spatial structure, while traffic islands serve as markers for intersections, U-turn points, and traffic flow guides (Hidayat, 2010). Because they are located in the center of the road space, these two

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elements are most easily visible to road users, so the condition of their vegetation significantly influences the overall visual quality of the corridor (Nurin et al., 2024).

Soekarno-Hatta Road is one of the main arterial corridors in the city of Palembang, stretching 8.4 km with high traffic volume; it serves as both a city ring road and a regional thoroughfare (Bahana and Rachmawati, 2015). Preliminary observations indicate that the medians and traffic islands along this corridor exhibit irregular planting patterns and, in some cases, appear poorly maintained, necessitating an objective and measurable evaluation of visual quality. Research on the visual quality of green corridors in Palembang remains limited, particularly along primary arterial corridors, as most previous studies have focused on public open spaces such as city parks and retention ponds (Rahmi, 2022). Meanwhile, a combination of the Scenic Beauty Estimation (SBE) and Semantic Differential (SD) methods has proven effective for evaluating the visual quality of road corridors in other regions (Krisnayana et al., 2020).

SBE method assesses landscape beauty based on respondents' perceptions of photographs (Daniel and Boster, 1976), while the SD method measures the visual character of a landscape using pairs of opposing adjectives such as neat–messy and clean–dirty (Osgood et al., 1957). Combining these two methods provides a complementary picture of a landscape's visual quality (Tveit and Ode Sang, 2014). Based on this description, this study aims to (1) describe the visual condition of the green belts on the medians and traffic islands along Soekarno-Hatta Street, (2) analyze their visual quality using the SBE and SD methods, and (3) formulate landscape design recommendations to improve the visual quality of these green belts.

2. Materials and methods

2.1. Experimental Location

The experiment was conducted from January –June 2025 along Soekarno-Hatta Street, Alang-Alang Lebar District, Palembang City, South Sumatra, covering a study area of approximately 165,177.57 m^2 at coordinates ranging from 2°59'17"S–104°43'07"E to 2°55'24"S–104°42'40"E.

Figure 1 Map of the Location and Distribution of Vantage Points on Soekarno-Hatta Road
Source: Google Earth (2025)

10 vantage points (Figure 1), as described in Chapter 3. Each vantage point represents four viewing directions, resulting in 40 landscapes for respondents to evaluate. The landscapes were coded sequentially as follows: VP 1 (L1–L4), VP 2 (L5–L8), VP 3 (L9–L12), VP 4 (L13–L16), VP 5 (L17–L20), VP 6 (L21–L24), VP 7 (L25–L28), VP 8 (L29–L32), VP 9 (L33–L36), and VP 10 (L37–L40). In addition to the road median, there are also traffic islands located at intersections. These traffic islands vary in size, with widths ranging from 4 to 8 meters to accommodate the geometry of the intersection. Traffic islands at intersections also serve as green corridor elements with high visibility. The condition of vegetation on these traffic islands influences road users' visual perception, particularly at points with high vehicle traffic intensity
On the 2-meter-wide road shoulders, freight vehicles are often parked, creating a visual obstruction for road users. This causes drivers' focus to be predominantly directed toward the median and traffic islands located in the center of the road corridor

2.1.1. Material, Equipment and Methods

The tools used included writing materials, Google Earth, GPS (Global Positioning System), a camera, a laptop, Adobe Photoshop CS6 software, and a smartphone. Primary data were obtained from field observations, landscape photographs, and respondent questionnaires, while secondary data were obtained from location maps, books, scientific journals, and relevant regulations. The study employed a quantitative descriptive method through field observations

and questionnaire surveys, with data analysis using the SBE method to assess aesthetic preferences and the SD method to measure the visual character of the landscape.

2.2. Data Collection Procedures

The research procedure included the preparation stage, data inventory, determination of vantage points, photography, visual quality assessment, and data analysis. A total of 10 vantage points were identified through field surveys to represent the visual conditions of the study site, with photographs taken at eye level and from four viewing directions at each point, resulting in 40 landscape photographs (L1–L40). The photographs were edited using Adobe Photoshop CS6 to ensure consistent image quality. Assessments were conducted by 50 respondents grouped into three age categories—17–25 years, 26–40 years, and ≥41 years. The SBE assessment used a scale of 1 (very unattractive) to 5 (very attractive), while the SD assessment used a 1–5 scale for 14 pairs of opposing adjectives, including narrow–wide, quiet–lively, uncomfortable–comfortable, unattractive–attractive, barren–lush, monotonous–varied, boring–fun, messy–organized, hot–shady, unoriginal–original, dirty–clean, dangerous–safe, neglected–well-maintained, and ugly–beautiful.

2.3. Data Analysis

The SBE value is calculated based on the frequency, cumulative frequency, cumulative probability, and Z-value of the respondents' scores, using the formula (Daniel and Boster, 1976):

$$SBEX = (ZYX - ZY0) \times 100$$

SBEX is the estimated beauty value of landscape x, ZYX is the average Z value of landscape x, and ZY0 is the average Z value of the standard landscape. The obtained SBE values are grouped into high, medium, and low categories based on class intervals derived from the difference between the maximum and minimum values. The SD value is calculated as the average of the respondents' rating weights for each criterion in each landscape photo (Osgood et al., 1957), using the formula:

$$X_j = \frac{\sum_{i=1}^{n} X_{ij}}{n}$$

Xj is the weighted average of criterion j, Xij is the weight of the i-th image for criterion j, and n is the number of respondents. The SBE and SD results are then presented in tables and graphs to facilitate the interpretation of visual conditions at each vantage point. Data processing was performed using Microsoft Excel.

3. Results

3.1. Respondent Characteristics

The visual assessment involved 50 respondents with a relatively balanced gender composition: 27 women (54%) and 23 men (46%). Respondents were predominantly in the working-age group, with 38% aged 26–40, 36% aged 17–25, and 26% aged 41 or older. Respondents' educational levels varied, with a majority holding bachelor's degrees (44%) and high school diplomas (40%), and the majority working in the private sector (54%). Sixty percent of respondents were non-local residents who frequently traveled through the corridor; 72% had been familiar with the area for more than five years; and 58% traveled through it daily—indicating a high level of familiarity among respondents with the conditions of the study landscape. In terms of initial perceptions, 88% of respondents stated that they pay attention to the condition of the greenway when passing through, 82% rated the greenway's condition as fairly comfortable to very comfortable, and 66% rated the greenway as enhancing to greatly enhancing the road corridor's aesthetics, which reinforces the relevance of visual assessment data based on the SBE and SD methods in the next phase.

3.2. Results of the Scenic Beauty Estimation (SBE) Assessment

The SBE assessment was conducted on 40 landscapes (L1–L40) observed from 10 vantage points.


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Figure 2 Visual Documentation of the Research Landscape

The highest SBE value was obtained in landscape L1 at 138.70, while the lowest value was in landscape L37 at −152.16. Based on the class intervals calculated from this range of values, the high category corresponds to SBE values greater than 41.74 up to 138.70, the medium category to values greater than −55.21 up to 41.74, and the low category to values from −152.16 to −55.21. A summary of the number of landscapes in each category is presented in Table 1 and Figure 3 below.

Table 1 Summary of landscape visual quality categories based on Scenic Beauty Estimation (SBE) scores

Category	SBE Value Range	Number of Landscapes	Examples of Highest/Lowest Landscapes
High (H)	> 41,74 s.d. 138,70	13	L1 (138,70), L8 (94,52), L10 (93,99)
Medium (M)	> −55,21 s.d. 41,74	21	L5 (33,18), L9 (11,62), L22 (28,70)
Low (L)	−152,16 s.d. −55,21	6	L37 (−152,16), L40 (−105,91), L15 (−103,38)

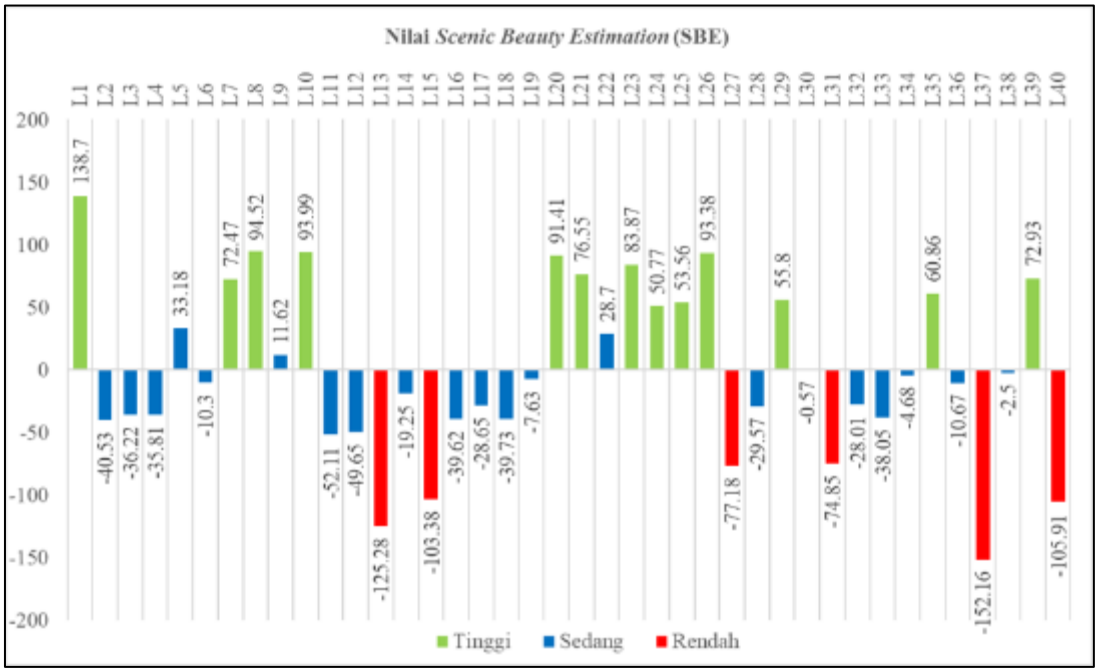

Figure 3 Scenic Beauty Estimation (SBE) Values Graph

Landscapes in the high category, including L1, L8, L10, L26, L20, L23, L21, L39, L7, L35, L29, L25, and L24—generally feature more orderly vegetation with plant compositions that enhance the green appearance and present a neat, uncluttered look for medians or traffic islands. The medium category, which includes the largest number of landscapes (21 landscapes), exhibits visual quality that is still acceptable but not yet fully robust, generally influenced by uneven vegetation composition or suboptimal planting patterns. Meanwhile, the six landscapes categorized as low; L31, L27, L15, L40, L13, and L37, indicate poorly organized vegetation as well as the presence of other visual elements that disrupt the appearance of the green corridor. The low SBE score for L37 aligns with the condition of vantage point 10, which should be prioritized for improvement.

3.3. Semantic Differential (SD) Assessment Results

The SD assessment was conducted based on 14 pairs of opposing adjectives on a 1–5 scale. The results show that the highest average score was found in landscapes L15 and L40 at 4.58, while the lowest score was found in landscape L37 at 2.55. Based on the overall average scores, the landscapes were grouped into three classifications, as presented in Table 2 and Figure 4 below.

Table 2 Summary of landscape visual quality categories based on Semantic Differential (SD) scores

Category	SD Average Score	Number of Landscapes	Examples of Landscapes
High (H)	≥ 3,4 (relatif)	13	L15 (4,58), L40 (4,58), L36 (4,57), L30 (4,11)
Medium (M)	≈ 3,0–3,4	13	L2 (3,32), L27 (3,33), L32 (3,28)
Low (L)	≤ 3,0 (relatif)	14	L37 (2,55), L18 (2,57), L34 (2,58)

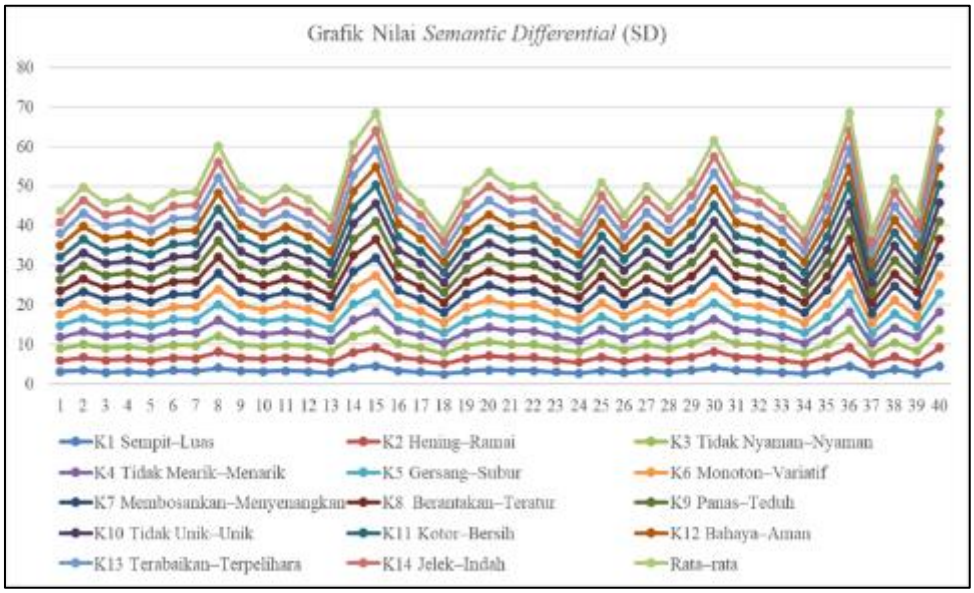

Figure 4 Graph of Semantic Differential (SD) Scores for Each Landscape

Across all 14 adjective criteria, landscapes L15, L36, and L40 consistently received the highest scores, while L18, L34, and L37 consistently received the lowest scores. This indicates that respondents perceived these three landscapes as spacious, comfortable, lush, varied, orderly, shaded, clean, safe, well-maintained, and beautiful, while landscapes with low scores tended to be perceived as cramped, uncomfortable, poorly maintained, and unattractive. The visual characteristics measured using the SD method complement the SBE results by explaining the specific attributes that shape the perception of beauty in each landscape (Li et al., 2021).

3.4. Relationship Between SBE and SD Ratings and Landscape Visual Quality

Comparison of the SBE and SD results shows that the two methods do not always yield the same classifications for the same landscape, as SBE emphasizes general aesthetic preferences, while SD evaluates specific visual characteristics based on pairs of adjectives. The overall relationship is shown in Table 3.

Table 3 Relationship Between Scenic Beauty Estimation (SBE) and Semantic Differential (SD) Scales and Landscape Visual Quality

Visual Quality Classification	Landscape Number	Relationship Between Scenic Beauty Estimation (SBE) and Semantic Differential (SD)
High (H)	SBE: L1, L8, L10, L26, L20, L23, L21, L39, L7, L35, L29, L25, and L24. SD: L8, L14, L15, L16, L20, L25, L29, L30, L31, L35, L36, L38, and L40.	Based on the SBE assessment, landscapes with high visual quality are characterized by: Better-organized vegetation elements that provide good visual orientation along green corridors. A vegetation composition that reinforces a green, neat, and visually pleasing impression. Median strips and traffic islands that are not overly cluttered and have a more visually appealing appearance. Thus, landscapes with high visual quality based on the SBE assessment tend to be comfortable, attractive, lush, varied, orderly, shaded, clean, safe, well-maintained, and beautiful.
Medium (M)	SBE: L5, L22, L9, L30, L38, L34, L19, L6, L36, L14, L32, L17, L28, L4, L3, L33, L16, L18, L2, L12, and L11. SD: L2, L4, L6, L7, L9, L10, L11, L12, L19, L21, L22, L27, and L32.	Based on the SBE assessment, landscapes with moderate visual quality are characterized by: Vegetation elements are still visible, but the regularity of the planting pattern is not yet fully optimal. The vegetation composition is sufficient to create a green impression, but does not yet provide a strong visual impact. Some landscapes are still influenced by surrounding elements, such as vehicular activity, billboards, or the appearance of the street space, which reduce the visual focus on the green corridor. Thus, landscapes with visual quality based on the SD assessment tend to be reasonably comfortable, reasonably attractive, reasonably orderly, reasonably shaded, reasonably clean, reasonably safe, and reasonably beautiful.
Low (L)	SBE: L31, L27, L15, L40, L13, and L37. SD: L1, L3, L5, L13, L17, L18, L23, L24, L26, L28, L33, L34, L37, and L39.	Based on the SBE assessment, landscapes with low visual quality are characterized by: Vegetation that appears disorganized, resulting in a poorly defined visual orientation along green corridors. A plant composition that lacks harmony or fails to enhance the green appearance of medians and traffic islands. The presence of other distracting visual elements, causing the landscape to appear untidy, uncomfortable, or unattractive. Consequently, landscapes with low visual quality, as assessed by the SBE, tend to be less attractive, less orderly, less well-maintained, less comfortable, less shaded, and do not yet provide an optimal visual impression.

Landscapes L8, L20, L25, L29, and L35 were classified as “high” under both methods, indicating that these landscapes are visually appealing and possess positive visual characteristics. Conversely, landscapes L13 and L37 were classified as low in both methods, making them top priorities in management recommendations. Differences in results were also found for several landscapes, such as L15, L31, and L40, which were classified as low in the SBE but high in the SD, as well as L1, which had the highest SBE score but was classified as low in the SD. These differences confirm that preferences for visual beauty are generally not always identical to assessments of visual character based on more detailed semantic criteria (Kang and Liu, 2022); thus, the simultaneous use of both methods provides a more comprehensive evaluation.

3.5. Factors Affecting Visual Quality

In general, the visual quality of the green belts on the medians and traffic islands along Soekarno-Hatta Road is influenced by four main factors: (1) the regularity of vegetation arrangement, which determines the rhythm and legibility of the road space (Nurin et al., 2024); (2) the neatness and intensity of maintenance, as plants that are regularly pruned and free of weeds give the impression of being well-maintained, while damaged or dead vegetation reduces aesthetic value (Bai et al., 2020); (3) the composition and variety of plant species, which enhance the impression of greenness and provide variation in texture and color (Agustin et al., 2021); and (4) the presence of surrounding visual elements, such as billboards, parked vehicles, and commercial activities, which can divert visual focus away from the green corridors. Medians and traffic islands, as the most visually prominent green corridor elements on arterial roads, play a strategic role in shaping the overall image of the Soekarno-Hatta Road corridor (Anciaes, 2022; Putra and Asmiwyati, 2025); therefore, their management must be carried out consistently across all vantage points, not just at locations with low visual value.

3.6. Management Recommendations

Based on the results of the SBE and SD assessments, management recommendations are formulated both generally and specifically for each vantage point. In general, management is directed toward: routine pruning of vegetation to maintain canopy shape and neatness; adding plants to empty areas to enhance the green appearance; replacing damaged, dead, or unsuitable plants; rearranging planting patterns to make them more orderly and uniform; and controlling visual disturbances such as billboards and parked vehicles around medians and traffic islands. Specifically, vantage points with high visual value (VP 1, VP 2, and VP 5) are recommended to be maintained through routine upkeep, while vantage points in the low-value category—particularly VP 4 and VP 10—require priority attention for vegetation rearrangement, the addition of ornamental plants or shrubs, and the reduction of disruptive visual elements. These recommendations are expected to improve the visual quality of the green belt uniformly along the Soekarno-Hatta Road corridor.

4. Conclusion

The visual quality of the green belts on the medians and traffic islands along Soekarno-Hatta Road is divided into three categories—high, medium, and low—based on vegetation composition, the regularity of planting patterns, plant species diversity, and the level of maintenance at each vantage point. The SBE results show 13 landscapes categorized as high,

21 as moderate, and 6 as low, with the highest score at L1 (138.70) and the lowest at L37 (−152.16). The SD results showed 13 landscapes categorized as high, 13 as moderate, and 14 as low, with the highest average scores at L15 and L40 (4.58) and the lowest at L37 (2.55). High-category landscapes are generally perceived as spacious, comfortable, lush, varied, orderly, shaded, clean, safe, well-maintained, and beautiful, whereas low-category landscapes are perceived as the opposite. There is a correlation between the SBE and SD results regarding the elements that constitute visual quality, where landscapes with well-organized and well-maintained vegetation tend to receive high scores in both methods. Overall, the visual quality of the Soekarno-Hatta Road green corridor is in fairly good condition, but it is not yet uniform; therefore, sustainable landscape planning and maintenance are needed, particularly at low-category vantage points, to improve the overall visual aesthetic quality of the road corridor.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

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