A Study of the potential collections of Javanese native tree species in the Bogor Botanical Garden for aesthetic functions in the landscape

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Abstract. The selection of tree species planted for aesthetic functions may vary based on their physical appearance and it is very important to use the species of the native trees for ecological purposes. The objectives of this research were to assess the ecological distribution and the aesthetical performance of the collections of the Javanese native trees at the Bogor Botanical Garden. The data were processed and analysed based on habitat distribution and morphological characteristics. Furthermore, the Key Performance Index Assessment Technique was used to give value to each criterion. The stages of tree aesthetic quality assessment were done by simulation using the method of Scenic Beauty Estimation (SBE). Total 469 species of the Javanese native trees were discovered. Based on the habitat distribution, the highest number describes the species of tree scattered throughout the Island of Java (237 species), Western Java (131 species), West and Central Java (53 species), Central Java (17 species), central and eastern Java (12 species), eastern Java (9 species), and western and eastern Java (7 species). Furthermore, the species of native trees also had a range of habitat altitude ranging from coastal (0 masl) to mountain (3100 masl). Then, based on the criteria of aesthetic assessment, they were categorized as good (43 species), medium (172 species) and bad (14 species).

1. Introduction
Tree plants in the landscape have a very important function for the life of other living things. For wildlife, trees act as providers of food and shelter, while for human, trees are useful for health and comfort in their daily activities. One of the functions of tree plants is to support the convenience of human activities and the aesthetic function. This function affects the user of the landscape psychologically [1].

As an important element in the landscape, the selection of the tree species within the landscape needs to be carefully considered. Regarding their aesthetic functions in the landscape, the selection of the tree species may vary based on their physical appearance. Characteristic types of tree plants used as a reference selection of plants include the size of the tree size, shape and texture of the canopy, etc [2].

Indonesia has a tropical climate that harbours a high biodiversity level of existing tree species. The biodiversity is affected by the variety of habitat types for tree plants [3]. In preserving the biodiversity, it is necessary to conserve them by ex-situ efforts that lead to the utilization of biological natural resources for human welfare [4]. One use that can be done is to preserve the existence of tree species as elements in the landscape, especially the built landscape such as city park and green streets. The
diversity of tree species can be observed in the collection of existing plants in the Botanical Garden. There can be seen various types of plants that can be a reference to be used as a main element in the landscape.

Based on the diversity of species, a thing to consider in addition to physical appearance is the ecological character of the tree species. Plants in the landscape are strongly influenced by the conditions of growing habitat. Therefore, we need to know the habitat type of the plant, especially in terms of altitude above sea level and water availability in the environment [3]. In previous studies, good ecological species are native tree species [3,5,6,7,8,9]. Native tree or other plant types that have their own significance for a region can also function as an identity giver of the area [10] in [11].

1.1. Objectives of the research
The general objective of this research was to examine the potential Javanese native tree collection at the Bogor Botanical Garden to fulfill the aesthetic function in the landscape. As for the specific purposes, they were as mentioned below:
1. To assess the ecological distribution of the collection of the Javanese native trees at the Bogor Botanical Garden
2. To assess the aesthetic performance of the collection of the Javanese native trees at the Bogor Botanical Garden

1.2. Scope of the research
The scope of this study was limited to the study of the collection of local Javanese tree species that can be used to fulfill aesthetic functions in some types of land use such as urban parks, neighboring parks and green streets. An aesthetic function was selected as the boundary of the scope of the study to find out the potential visual quality of the Javanese native tree collection. The definition of Javanese native tree species in this study was a type of tree that can live and come from Java. The information was acquired from data owned by the Bogor Botanical Garden. The function of the tree plants studied was limited to the aesthetic aspects in order to be able to be analyzed visually based on morphological criteria. The observed tree species were limited within the scope of the solitary tree collection, viewed closely, and the observer condition is in a fixed state. The tree species studied were also limited by the collection of plants owned by the Bogor Botanical Garden.

2. Methods

2.1. Location and time of the research
This research was conducted in a suitable place for the purpose of collecting data or information collected. Information on local tree species was obtained from Bogor Botanical Garden (KRB). The limits of the study sites in KRB can be seen in figure 1. This study started in October 2014 and finished in April 2017.

2.2. Research approaches
This research was conducted through field survey, literature study, and simulation. The research procedure was divided into 4 stages: (1) collection and grouping of tree data, (2) processing and analysis of tree data, (3) compilation and assessment of tree aesthetics criteria, and (4) assessment of tree aesthetics with Scenic Beauty Estimation method. The results of the processing and assessment of the tree data were used as reference for recommendation of tree species that were potential to be developed for aesthetic function in the landscape.
2.2.1. Collecting and grouping tree data. Data of examined tree species were obtained by literature study on botanical garden and a tree catalog collection. The acquired data was limited to the tree species originating from the Island of Java. The criteria for the origin of tree species was derived from the original information contained in the collection catalog of the botanical garden. Furthermore, the list of tree species was equipped with pictures of trees taken using a digital camera. Photos taken included photos of a whole tree, the shape of branching, the shape of the canopy, as well as the interesting parts of the tree such as the stems, flowers, and fruits.

Collections of tree species at the Bogor Botanical Garden were arranged using a planting system called VAK. Each VAK had a VAK marker and between one and another VAK is usually limited by road, river, or building (figure 2). At the Bogor Botanical Garden, the collection of tree species originating from Java was expanded in 130 VAK (figure 3). Furthermore, the collection of tree species was searched by using the map of the planting point owned by the botanical garden. At the Bogor Botanical Garden, the planting point maps were obtained from garden map books owned by each of the 12 garden environmental guards (figure 4). Further data on altitude and habitat distribution of each tree species were collected through literature study by Backer et al. [12], that has denoted the maximum height, minimum altitude, and habitat distribution of tree species studied.
2.2.2. Data Processing and Analysis of tree. Data of collected tree species were further processed and analyzed based on habitat distribution and morphological characteristics. The habitat distribution data was then analyzed to obtain the horizontal and vertical distribution charts of the local Javanese tree species studied. Furthermore, the morphological characters for the aesthetic assessment criteria studied were the canopy form, the crown texture, the branching structure, the appearance of the stems, leaves, flowers, and fruits. The forms of the tree canopy were categorized into 7 types: rounded, picturesque, spreading, fastigiated (oval), columnar, pyramidal, and weeping (figure 5).
2.2.3. Arranging and evaluating the aesthetic criteria. Furthermore, the Key Performance Index (KPI) assessment technique was used to give value to each criterion [14]. The aesthetic assessments of the tree species were then carried out based on several criteria obtained from various sources [1,15,16,17,18,19,20,21]. Each criterion was scored ranging from 1 to 5 in accordance with the criteria assessed. The aesthetic assessment criteria were mentioned below.

1. Clarity and canopy form recognition (A1)
2. Canopy size (A2)
3. Canopy visual texture (A3)
4. Canopy width dimension (A4)
5. Canopy openness (A5)
6. Regularity of branching structures (B1)
7. The existence of thorns on the stem/branch (C1)
8. Variation of stem color (C2)
9. Variation of leaves color (D1)
10. The existence and variation of flower color (E1)
11. The existence and variation of fruit color (F1)

Measuring the weight against the value obtained from the assessment of aesthetic criteria. This was conducted because these criteria have different impressions and effects on aesthetic qualities perceived by users [22]. Therefore, the weight was measured on the strength of the effect of the aesthetic criteria to the user (table 1).

Table 1. Aesthetics criteria weighting.

| No | Criteria                                      | Value range | Level of influence    | Weighting coefficient | Total value range |
|----|-----------------------------------------------|-------------|-----------------------|-----------------------|-------------------|
| 1  | A1 (Recognizing the Clarity and canopy form)  | 1 – 5       | More stronger         | 1.33                  | 1.3 – 6.7         |
| 2  | A2 (Canopy size)                              | 1 – 5       | Less stronger         | 0.5                   | 0.5 – 2.5         |
| 3  | A3 (The visual texture of the Canopy)         | 1 – 5       | Slightly stronger     | 1.17                  | 1.2 – 6           |
| 4  | A4 (The width dimension of the Canopy)        | 1 – 5       | Less stronger         | 0.5                   | 0.5 – 2.5         |
| 5  | A5 (Canopy openness)                          | 1 – 5       | Strong                | 1                     | 1 – 5             |
| 6  | B1 (Regularity of branching structures)       | 1 – 5       | Strong                | 1                     | 1 – 5             |
| 7  | C1 (The existence of thorns)                  | 1 – 5       | Less stronger         | 0.5                   | 0.5 – 2.5         |
| 8  | C2 (The variation of the colors of the stem)   | 1 – 5       | Strong                | 1                     | 1 – 5             |
| 9  | D1 (The variation of the colors of the leaves) | 1 – 5       | Very strong           | 1.5                   | 1.5 – 7.5         |
| 10 | E1 (The existence and variation of the color of the flower) | 1 – 5 | Very strong | 1.5 | 1.5 – 7.5 |
| 11 | F1 (The existence and variation of the color of the fruit) | 1 – 5 | Strong | 1 | 1 – 5 |

Figure 5. Types of canopy form [2].
Furthermore, the value was added and then divided by the maximum possible value and multiplied by 100%. The percentage was then be defined as a score and grouped by quality category with the following conditions:

- **Very Good**, if achieved a percentage of \( \geq 81\% \) criteria fulfilled
- **Good**, with a percentage of \( 61 \sim 80 \% \) criteria fulfilled
- **Medium**, with a percentage of \( 41 \sim 60 \% \) criteria fulfilled
- **Bad**, with a percentage of \( \leq 40 \% \) criteria fulfilled

### 2.2.4. Aesthetics quality assessment by Scenic Beauty Estimation

The stages of tree aesthetic quality assessment were simulated by using the Scenic Beauty Estimation (SBE) method. This method was introduced by Daniel and Boster [23] as a procedure of beauty prediction by evaluating the visual quality of a landscape, where in this study the landscape limits used were the visual elements of tree species. The implementation of the SBE method consisted of three main steps: (1) taking photos, (2) photo slide presentations, and (3) data analysis. Photographs of the tree species were considered to be selected from each group of tree species canopy forms compiled based on the assessment of aesthetic criteria in the previous stage. The selected tree species were those with the highest and lowest aesthetic scores. In the SBE method, each tree photo slide was displayed within 8 seconds and was assessed on the SBE questionnaire sheet provided by the respondents.

Then the assessment was conducted by 60 respondents with the same academic background or study field. Respondents were consisted of undergraduate and postgraduate students of IPB Landscape Architecture Study Program. Respondents provided scores with a scale of 1–10 on photos where the more favored selections took the higher score and vice versa. The result of the respondent's assessment was next processed by calculating the cumulative frequency counts, the cumulative chance, the \( Z \) score, and the average \( Z \) score, then determined the \( Z \) score of the particular species photo as the standard. Photographs of the standard species were assigned to species having a near zero average \( Z \) score that can be used to estimate the aesthetic quality of photographs of other species relative to the midpoint of the rating scale [24]. Furthermore, the SBE value was formulated in equation 1 [23]:

\[
SBE_x = (ZL_x - ZL_s) \times 100
\]

**Explanation:**

- \( SBE_x \) = SBE score for landscape number \( x \)
- \( ZL_x \) = average score \( Z \) for landscape number \( x \)
- \( ZL_s \) = average score \( Z \) for standard landscape

Based on the value of SBE obtained, each photo was classified using a standard by Daniel and Boster [23] that was modified. The classification was based on the level of aesthetic quality into 3 categories: low, medium, and high. The class interval value was obtained based on the calculation of the maximum SBE value minus the minimum SBE value obtained and divided by the number of classification levels with the following equation 2 [25]:

\[
\text{class interval value} = \frac{\text{maximum SBE score} - \text{minimum SBE score}}{n \text{ classification level}}
\]

### 3. Result and Discussion

#### 3.1. Javanese native tree collection in the Bogor Botanical Garden (KRB)

Based on the catalog of plant collections existing in the KRB, it was investigated the species of trees’ attributes of information as they are collections imported from numerous areas in Java [13]. The collection consists of 469 species, which belongs to 85 families. Then, the location of the planting point of the tree species collection was discovered by using the environmental book owned by the
supervisor of the garden. However, not all the species of trees in the catalog could be found in the environmental books. This occurred because the data in the catalogs had been published using the data in 2010, while the environmental book used the actual condition data. Based on observations undertaken in the field, 27 well-known species have been introduced as well through the information included on the plant labels. Furthermore, there were 26 dead species and 80 species which could not be found in the field. As many as 229 species could be identified by the form of the canopy while unidentified species reached total number of 105 species. This happened because the species of the tree which have been studied possessed a form that was difficult to recognize, with a size which was still small, where the canopies were too close to other species or uprooted.

3.2. Horizontal and vertical distribution of Javanese native tree species
Based on the data obtained from the field, the plant collection at the Bogor Botanical Gardens and Flora of Java, then the horizontal and vertical distribution of the data from the tree species were fabricated. The horizontal distribution was the geographical distribution of the tree species on the island of Java, in this case divided into 3 dispersal zones as mentioned below [13]:

a. Western Java, which consisted of the Province of West Java, Banten, and DKI Jakarta
b. Central Java, which consisted of the Province of Central Java and Yogyakarta
c. Eastern Java, which consisted of the Province of East Java

Based on the data obtained from the tree species studied, there were 131 tree species that had a distributed habitat in western Java, 17 tree species in central Java, 9 tree species in eastern Java, 53 tree species in western and central Java, 12 tree species in central and eastern Java, 7 tree species in western and eastern Java, and 237 tree species having a distributed habitat in all the areas of Java (figure 6). However, among these species there were 49 species of trees which were categorized as introduced species [13].

![Figure 6. Horizontal distribution of Java native tree collection.](image)

Furthermore, the vertical distribution of the tree species was based on the habitat in terms of altitude from above the sea level. The distribution habitat was determined from the data of a minimum and maximum altitude of the tree species which could be identified. In this study the expanding habitat was divided into the following zones [26]:

a. Zone A/Tropical Zone, with an altitude of habitat 0 – 1000 masl
b. Zone B/Mountain Zone, with an altitude of habitat 1000 – 2400 masl
c. Zone C/Subalpin Zone, with an altitude of habitat 2400 – 5000 masl
d. Zone D/Tropic – Mountain Zone, with an altitude of habitat 0 – 2400 masl
e. Zone E/Mountain – Subalpin Zone, with an altitude of habitat 1000 – 5000 masl
f. Zone F/Tropic – Mountain – Subalpin Zone, with an altitude of habitat 0 – 5000 masl

Based on data obtained from tree species studied, there were 177 tree species included in Zone A, 5 tree species included in Zone B, 111 tree species belonging to Zone D, 3 tree species in Zone F, however no tree species found in Zone C and Zone E (figure 7).

3.3. The aesthetic criteria assessment of Javanese native tree species
The criteria assessment was performed based on the type of tree and canopy species studied. The groups were mentioned below:

3.3.1. Rounded shape Javanese native tree species group. The number of tree species with rounded-shaped canopy was 68. Out of these, as many as 17 species were included in a good category with a score range of 60.61% – 75.15% fulfilling the criteria of an aesthetic assessment. Furthermore, as many as 47 species were included in the medium category with score range of 40.30% – 58.48%. Then, there were 4 species included in the bad category with a score range of 35.15% – 40.00%. The tree species with the highest score was Bouea macrophylla Griff (Anacardiaceae) and the lowest score was Kleinhovia hospita L. (Sterculiaceae) (figure 8 and 9).

3.3.2. Columnar shape Java native tree species group. There were 31 number of tree species which had a columnar-shaped canopy. Out of these, as many as 4 species were included in a good category with a score range of 60.30% – 63.33% fulfilling the criteria of aesthetic assessment. Then as many as 25 species were included in the medium category with a score range of 41.21% – 57.88%. Furthermore, there were 2 species included in the bad category with a score range of 36.06% and 39.39%. The tree species columnar which had the highest score was Cyathocalyx martabanicus Hoo k.f & Thomson (Annonaceae) and the lowest score was Syzygium formosum (Wall.) Masam (Myrtaceae) (figure 10).
Figure 8. *Bouea macrophylla* Griff.

Figure 9. *Kleinhovia hospita* L.

Figure 10. *Cyathocalyx martabanicus* Hook.f. & Thomson and *Syzygium formosum* (Wall.) Masam.
3.3.3. Irregular shape of the species group of the Javanese native tree. There were 2 trees species with an irregular-shaped canopy. Out of these, 1 species, which was the Buchanania arborescens (Blume) Blume (Anacardiaceae) (figure 11) was categorized into good category with a 63.33% score fulfilling the aesthetic valuation criteria. Then one other species was included in the medium category with a score of 41.52% is Terminalia bellirica (Gaertn.) Roxb (Combretaceae) (figure 12).

![Figure 11. Buchanania arborescens (Blume) Blume.](image)

![Figure 12. Terminalia bellirica (Gaertn.) Roxb.](image)

3.3.4. The type of Javanese native tree species group with a Weeping shape. There were 13 trees species with a weeping-shaped canopy. Out of these, as many as 5 species were included into good category with a score range of 62.73% – 69.09% which has fulfilled the criteria of aesthetic assessment. Then as many as 8 species were included in the medium category with a score range of 49.39% – 58.79%. The weeping tree species with the highest score was Cocos nucifera L. (Areaceae) (figure 13) and the lowest score was Licuala spinosa Wurmbl (Areaceae) (figure 14).
3.3.5. *The type of Javanese native tree species group with an Oval shape.* There were 56 species of oval-shaped canopy trees. Out of these, as many as 5 species were included in good category with a score range of 60.91% – 71.52% fulfilling the criteria of aesthetic assessment. Furthermore, as many as 46 species were included in the medium category with a score range of 40.30% – 58.48%. Furthermore there were 5 species included into bad category with a score range of 35.15% – 38.18%. The species of oval trees with the highest score was *Garcinia mangostana* L. (Clusiaceae) and the lowest score tree was *Berrya javanica* (Turcz) Burret (Tiliaceae) (figure 15).

3.3.6. *The type of Javanese native tree species group with a pyramidal shape.* There were 20 species of trees with a pyramidal-shaped canopy. Out of these, 1 species namely the *Syzygium claviflorum* (Roxb.) Wall belonged to the good category. Ex A.M. Cowan & Cowan (Myrtaceae) with a score of 63.64% fulfilled the criteria of aesthetic assessment and was enlisted as the highest score species
(figure 16). Then as many as 18 species were included in the medium category with a score range of 42.42% – 58.48%. Furthermore, there was 1 species included in the bad category with a score of 39.39%. The pyramidal tree species with the lowest score was Shirakiopsis indica (Willd.) Esser (Euphorbiaceae) (figure 17).

![Figure 15. Garcinia mangostana L. and Berrya javanica (Turcz) Burret.](image)

![Figure 16. Syzygium claviflorum (Roxb.) Wall. Ex A.M. Cowan & Cowan.](image)

3.3.7. The type of Javanese native tree species group with a Spread shape. There were 39 number of tree species with a spread-shaped canopy. Out of these, as many as 10 species were included in good category with a score range of 60.30% – 74.24% which has fulfilled the criteria of aesthetic assessment. Furthermore, as many as 27 species were included in the medium category with a score range 40.30% – 59.70%. In this distribution, the 2 species of trees in this tree group were included in the bad category with a score of 33.33% and 33.94%. The species with the highest score was
Antidesma montanum Blume (Euphorbiaceae) (figure 18) and the lowest score was Theobroma cacao L. (Sterculiaceae) (figure 19).

Figure 17. Shirakiopsis indica (Willd.) Esser.

Figure 18. Antidesma montanum Blume.

Figure 19. Theobroma cacao L.
3.4. Aesthetic assessment using Scenic Beauty Estimation method
Based on the assessment of the esthetic criteria of the tree species in the Bogor Botanical Garden, 14 species of trees with the lowest and highest score were obtained in each canopy group (table 2). Furthermore, photographs of the tree species were modified by setting the background of the tree black and white in order for the respondents to rate the photos of the observed tree (figure 20). Based on the results of the SBE calculations, it was determined that the species of trees with an average Z value close to 0 was the Theobroma cacao L. ie -0.06071 and used as a photo as the standard species. The species achieved a score of 5 and 6 therefore, it achieved an average Z value close to 0 and was assumed to have a landscape aesthetic value between high and low or could be determined as normal aesthetic [24].

Based on the assessment from the respondents, the results of the SBE calculation were acquired in table 3. Afterwards, classification was undertaken by calculating the class interval value obtained from the maximum score of the SBE minus the minimum score of the SBE then divided by the number of the classification class. The photos of the tree species with maximum SBE was Garcinia mangostana L. with a score of 87, while Theobroma cacao L. earned the minimum score of SBE of 0. There were 3 classifications which were high, medium, and low. Based on the calculation, then the grouping was performed with the following provisions:

a. Low aesthetic qualities with a range of SBE scores 0 – 29
b. Medium aesthetic qualities with a range of SBE scores 30 – 59
c. High aesthetic qualities with a range of SBE scores 60 – 87

Table 2. List of tree species examined using the SBE method.

| No | Canopy form | High scored tree species | Low scored tree species |
|----|-------------|--------------------------|-------------------------|
| 1  | Rounded     | Bouea macrophylla Griff  | Kleinhovia hospita L.   |
| 2  | Columnar    | Cyathocalyx martabanicus Hook. f. & Thomson | Syzygium formosum (Wall.) Masam |
| 3  | Irregular   | Buchanania arborescens (Blume) Blume | Terminalia bellirica (Gaertn.) Roxb. |
| 4  | Weeping     | Cocos nucifera L.        | Licuala spinosa Wurmb    |
| 5  | Oval        | Garcinia mangostana L.   | Berrya javanica (Turcz.) Burret |
| 6  | Pyramidal   | Syzygium claviflorum (Roxb.) Wall. Ex A.M. Cowan & Cowan | Shirkiopsis indica (Willld.) Esser |
| 7  | Spread      | Antidesma montanum Blume. | Theobroma cacao L.       |

Total 7 species of these trees belonged to the high category, whilst other 6 species were in the medium category, and 1 species was in the low category (table 3). The tree species included in the high category were Cyathocalyx martabanicus Hook. f. & Thomson, Buchanania arborescens (Blume) Blume, Shirkiopsis indica (Willld.) Esser, Cocos nucifera L., Bouea macrophylla Griff, Antidema montanum Blume, Garcinia mangostana L. The range of values obtained from the collection of the local tree species was 68 – 87 which was in the high category. Species of trees included in the medium category were Licuala spinosa Wurmb, Kleinhovia hospita L., Syzygium formosum (Wall.) Masam, Berrya javanica (Turcz.) Burret, Syzygium claviflorum (Roxb.) Wall. Ex.A.M Cowan & Cowan, and Terminalia bellirica (Gaertn.) Roxb. The range of values obtained in the medium category was 30 - 47. Trees species included in the low category was the Theobroma cacao L. with a low category of 0.
Figure 20. The photos of the tree species for SBE assessment.
Table 3. SBE score of the studied tree species.

| No | Name                                                      | Score | Z  | Z x 100 | SBE Score | Aesthetics quality |
|----|-----------------------------------------------------------|-------|----|---------|-----------|--------------------|
| 1  | Syzygium formosum (Wall.) Masam                           | 0.2831| 28 | 34      | medium    |
| 2  | Shirakiopsis indica (Willd.) Esser                       | 0.6469| 65 | 71      | high      |
| 3  | Terminalia bellirica (Gaertn.) Roxb.                     | 0.4077| 41 | 47      | medium    |
| 4  | Cocos nucifera L.                                        | 0.6601| 66 | 72      | high      |
| 5  | Kleinhovia hospita L.                                    | 0.2582| 26 | 32      | medium    |
| 6  | Cyathocalix martabanicus Hook.f. & Thomson               | 0.6157| 62 | 68      | high      |
| 7  | Berrya javanica (Turcz.) Burret                         | 0.3738| 37 | 43      | medium    |
| 8  | Antidesma montanum Blume                                 | 0.7975| 80 | 86      | high      |
| 9  | Syzygium claviflorum (Roxb.) Wall. Ex A.M. Cowan & Cowan| 0.3967| 40 | 46      | medium    |
| 10 | Bouea macrophylla Griff                                  | 0.7829| 78 | 84      | high      |
| 11 | Buchanania arborescens (Blume) Blume                     | 0.6205| 62 | 68      | high      |
| 12 | Licuala spinosa Wurmb                                    | 0.2398| 24 | 30      | medium    |
| 13 | Theobroma cacao L.                                       | -0.0607| -6 | 0       | low       |
| 14 | Garcinia mangostana L.                                   | 0.8046| 80 | 87      | high      |

Furthermore, the results of the SBE score were then compared with the aesthetic criteria score to determine the value trends obtained by each species. A comparison of the aesthetics scores and results of the SBE scores from samples of the collected tree species of KRB can be seen in table 4. Based on these comparisons, generally the scores obtained by both the aesthetic criteria and the SBE method portrayed the same tendency except in the pyramidal canopy group.

Table 4. The aesthetics score and the SBE score comparison.

| No | Canopy form | High scored tree species | Low scored tree species |
|----|-------------|--------------------------|-------------------------|
| 1  | Rounded     | Bouea macrophylla Griff, Cyathocalix martabanicus Hook.f. & Thomson | Kleinhovia hospita L., Syzygium formosum (Wall.) Masam |
| 2  | Columnar    | Buchanania arborescens (Blume) Blume | Terminalia bellirica (Gaertn.) Roxb. |
| 3  | Irregular   | Cocos nucifera L. | Licuala spinosa Wurmb |
| 4  | Weeping     | Garcinia mangostana L. | Berrya javanica (Turcz.) Burret |
| 5  | Oval        | Syzygium claviflorum (Roxb.) Wall. Ex A.M. Cowan & Cowan | Theobroma cacao L. |
| 6  | Pyramidal   |                        | Shrirakiopsis indica (Willd.) Esser |
| 7  | Spread      | Antidesma montanum Blume. |                         |
Figure 21. Aesthetics score and SBE score comparison chart.

Furthermore in figure 21, to compare the aesthetic scores and the SBE scores of local tree collections in KRB, most of the results displayed the same trend of results. On the chart, it could be seen that the species of the trees with a high aesthetic score also exhibited a high SBE score, and vice versa. However, there were differences in the outcomes in the pyramidal-shaped canopy type - group. In the pyramidal canopy type - group, the score of the SBE obtained by the species of high aesthetics was smaller than the score of the SBE obtained by the low aesthetics score tree species. The differences in the results of the assessment of the aesthetic criteria and the value of SBE occurred in the species gathered for pyramidal canopy formed groups in KRB respectively Syzygium claviflorum (Roxb.) Wall and Shirakiopsis indica (Willd.) Esser.

In the assessment using the SBE method, respondents gave a higher score for Shirakiopsis indica (Willd.) Esser as ranged in figures of 6.7, and 8, while for Syzygium claviflorum (Roxb.) Wall as ranged in numbers 5.6, and 7. This was in contrast to the assessment by the method of aesthetic criteria, Syzygium claviflorum (Roxb.) Wall got a higher score than Shirakiopsis indica (Willd.) Esser. Significant scores differed in A1 criteria (clarity of canopy shape), B1 (regularity of branching structure), D1 (leaves color variation), and E1 (flower color and existence). Differences scores occurred in the criteria that could be observed in detail by using the assessment of the aesthetic criteria. This could not be done with the SBE method that has been conducted by a spontaneous response from the respondents who did not have enough time to observe the sample species photo in detail.

4. Conclusion

Based on the research results, it could be concluded that the distribution of the habitat of the Javanese local tree species collections in the KRB were classified in each region. The largest number were tree species distributed throughout Java (237 species), followed by western Java (131 species), western and central Java (53 species), central Java (17 species), central and eastern Java (12 species), eastern Java (9 species), and the least was western and eastern Java (7 species). Furthermore, the local tree species also possessed a range of habitat altitude ranging from the coastal zones (0 mdpl) to mountain areas (3100 masl). Based on the data gathered, most of the species of local trees could grow well in tropical zones (0 – 1000 mdpl) and tropical zones up to the mountains (0-2400 mdpl).
The biodiversity of the local tree species in the Bogor Botanical Garden was quite high which summed up to 469 species. There were 43 tree species studied in KRB, based on the criteria assessment included in the good category, 172 species were in the medium category, and 14 species were categorized as bad. The highest aesthetic criteria score on the Javanese local tree collection in KRB was the Bouea macrophylla (Anacardiaceae) with a score of 75.15%, whilst the lowest score was the Theobroma cacao (Sterculiaceae) with 33.33%.

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