Preservation of heritage trees on the De Groote Postweg Lane in Bogor City

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Abstract. Bogor City has been designated as a national heritage city in 2012 through The National Program on Management and Conservation of Heritage City (P3KP). The conservation of heritage areas in Bogor City should not only be focused on physical man-made elements and land-use, but should also include natural elements such as trees which have historical values or named as heritage trees. This study indicates showed that the trees classified as heritage trees amount up to 281 which belongs to 17 species and 8 families. The tree species with the largest number of heritage trees is the kenari-nut tree (Canarium commune L.) where there are 220 of them. The proposed recommendation for the preservation of heritage trees and landscape characteristic strengthening consisted of three parts, namely: i) maintenance of heritage trees, ii) improvement of the growing environment, and iii) strengthening landscape characteristics. In the maintenance of heritage trees, all of the trees especially for kenari-nut tree (Canarium commune L.) should be maintained based on the type and extent of the damage. Improvement the growing environment can be conducted on the unfavorable conditions and followed by the planting of similar tree such as kenari-nut tree (Canarium commune L.) in empty spaces. To strengthen the landscape characteristics can be conducted by providing interpretation boards or other elements that could help people recognize the heritage trees, and the feel of heritage landscape.

1. Introduction

Bogor City is one of the cities incorporated in the Indonesian Heritage City Network (JKPI) within the Program on Management and Conservation of Heritage City (P3KP) with the main objective is to preserve heritage assets and urban heritage character. Bogor City’s heritage assets can not be separated from the history of the Great Post Road (De Groote Postweg in Dutch) in colonial period. De Groote Postweg Lane is not only a physical structure of the road, but also includes natural elements such as trees. But the historical values of the trees along the De Groote Postweg Lane is often overlooked in the preservation of historic areas. The ignorance of society also causes a lack of awareness of the importance of history, traditions, meanings, symbols, and values contained in an objects, places, and elements of the historical area.

According to Wirawan [1], from August to September 1744 Governor-General Baron van Imhoff was interested in developing the founder village of Bogor as a farm and a resort. In 1808, Governor-General Hermann William Daendels ordered the construction of De Groote Postweg passing through Bogor City to Tajur and Cipanas. Major changes occurred in Buitenzorg along with the presence of
Governor General Thomas Stanford Raffles in 1811. Raffles made the rest house an official palace but the government remained in Batavia. De Groote Postweg which passes Bogor City is currently known as Ahmad Yani Street, Jendral Sudirman Street, Ir. H. Juanda Street (Groote Weg), Surya Kencana Street (Handelsstraats).

Based on Act No. 26 Tahun 2007 about Spatial Arrangement [2], the implementation of spatial arrangement must pay attention to various aspects, including the historical value in a site. Implementation of spatial arrangement should be realized in accordance with the efforts of preservation and protection of cultural heritage. The need to preserve and structuring the heritage assets is in line to Act No. 11 Tahun 2010 about cultural heritage [3] which describes that the cultural heritage represents the nation's wealth as a form of thought and behavior of human life. Bogor City has been designated as a heritage city in 2012, based on the Program on Management and Conservation of Heritage City (P3KP). Bogor City Heritage Area is divided into 6 zone consisting of Bogor Palace Area, European Settlement Area, Chinatown Area of Surya Kencana, Empang Area, Karsten Plan Area, and West Expansion Area. De Groote Postweg Lane in Bogor City crossed the European Settlement Area, the Bogor Palace Area, and the Chinatown Area of Surya Kencana. Conservation efforts of the Bogor City Heritage Area should include the preservation of natural elements such as trees which in this case is a heritage tree. The preservation of the heritage trees is not only valuable for understanding as an integral part of a heritage, but also has historical, cultural, and scientific values as well as ecological and aesthetic values of the city.

Based on City Mayor Regulation of Bogor Nomor 17 Tahun 2015 on the Implementation of Bogor City as a Heritage City [4], the heritage tree is an old tree or group of trees that has historical or important value related to science, culture and beliefs for people in a region. Bogor City has many trees that can be designated as a heritage tree, including kenari-nut trees along the Great Post Road (De Groote Postweg) which were introduced and planted in the colonial period, and lychee tree in Bogor Botanical Garden which became the first tree planted. Efforts to conserve heritage trees and landscape management on the De Groote Postweg Lane also became a systematic and integrated effort that was undertaken to preserve environmental functions and prevent damage to the heritage assets present on the path. Therefore, heritage tree conservation-based research is important as a form of participation in supporting the implementation of Management and Conservation of Heritage City Program (P3KP) aimed at maintaining heritage assets for assisting the preservation of heritage tree and landscape character strengthening on the De Groote Postweg Lane.

The objectives of this research were to i) map and classify trees that were estimated being a heritage tree; ii) identify the trees based on the physical aspect, historical aspect, and landscape aspect; and iii) draw up recommendations for preservation of heritage tree and landscape character strengthening on the De Groote Postweg Lane in Bogor City.

2. Methods

This research was carried out on the De Groote Postweg Lane in Bogor, West Java Province including Jendral Ahmad Yani street, Jendral Sudirman street, Ir. H. Juanda street, up to Surya Kencana street and implemented from May 2016 to May 2017. This research was consisted of in four phases including inventory, data analysis, synthesis, and collection of recommendation for preservation of heritage tree and landscape character strengthening along De Groote Postweg Lane. The phases described as:

2.1. Inventory

On this stage, primary and secondary data were collected. Primary data collected from direct observation by Lane Transect method along 1000 m as transect and 100 m as segment in transect. Transects consisted of 6 transects along Jalan Jendral Ahmad Yani, Jalan Jendral Sudirman, Jalan Ir. H. Juanda, up to Jalan Surya Kencana with total length of 6.58 km in figure 1. Primary data were recorded by identifying trees based on physical aspects, landscape aspects, and historical aspects.
Secondary data in the form of literature study for historical aspect and data acquisition from related institution such as Space Structure Map of Bogor City (figure 1).

![Image](image_url)

**Figure 1.** De Groote Postweg Lane in Bogor City.

2.2. **Analysis**  
The analysis used a qualitative-quantitative method on attribute the heritage tree on the De Groote Postweg. Qualitative methods are used to describe tree species and morphology, architectural functions, historical value and period. The quantitative method used is the estimation of tree age to analyze tree age, tree health, growing environment, and ecological excellence that affect the roadside tree suitability. The dispersion map of the heritage tree is used as the actual tree position indicator on the De Groote Postweg Lane.

2.2.1. **Tree species and morphology.** Morphological analysis refers to Tjitrosoepomo [5], who explained that plant morphology divided is into two, namely primary and secondary morphology. Primary morphology consists of root, stems, and leaves, while flower, fruit, and seed are classified as secondary morphology. The canopy forms were analyzed in accordance with the Tree Planting Guide Lanes on Road Network Systems [6].

2.2.2. **Tree age.** Tree age calculation using age estimation based on equation 1:

\[
\text{Estimation of age} = \frac{K}{\bar{x}} \tag{1}
\]

\(K\): circumference on the dbh (diameters at breast height) cm  
\(\bar{x}\): average stem circumference increase of 2.5 cm

2.2.3. **Historical value and period.** Historical value was analyzed based on the relation with historical values on the De Groote Postweg Lane and the development of Bogor City.

2.2.4. **Tree health.** Tree health analysis was done based on Forest Health Monitory (FHM) (Mangold [7] in Miardini [8]). Damage assessment recorded based on location, type, and severity class. Data
collected from damage assessment were used for calculation of damage index based on code and damage index value and can be detected the health class of the tree

2.2.5. Growing environment. Based on Hidayat [9] and Utami [10], growing environment of heritage tree analyzed with Key Performance Index. The parameters consist of tree spacing to pavement, tree planting distance of each other, closing of street lights, no damage to street structure, and branching. The assessment of the parameters used accumulated scoring method to determine class criteria. Class criteria obtained by following equation 2:

$$\text{KPI (Key Performance Index)} = \frac{\text{Total of each parameter}}{\text{Maximum value of each parameter}}$$

(2)

2.2.6. Ecological excellence. Heritage tree ecological excellence is also analyzed using Key Performance Index (Hidayat [9] and Utami [10]). The parameters consist of guiding, rainwater velocity and erosion, light blocking, noise absorbers, pollutant reducers, and wildlife habitat. Assessment to parameters using accumulated scoring to determine class criteria. Class criteria obtained using following equation 3:

$$\text{KPI (Key Performance Index)} = \frac{\text{Total of each parameter}}{\text{Maximum value of each parameter}}$$

(3)

2.2.7. Architectural function. The architectural function analysis referred to Hakim [11], architectural function commonly consisted of visual control, physical barriers, climate control, erosion control, and aesthetics values

2.2.8. Roadside tree suitability. The analysis of roadside tree suitability is a combination of tree health, architectural function, ecological excellence, and the growing environment of the heritage tree based on Tree Planting Guidance on Road Network Systems. The suitability of the roadside tree is also influenced by the shape of the canopy and the branching form, so it can be known which tree species are suitable for the roadside tree.

2.3. Synthesis
In synthesis phase, the correlation between data and obtained information resulted from the analysis was tested as a foundation to determine the location and condition of heritage tree, and also problem and potentials related to of heritage tree preservation. The results can be integrated to reach the mapping goal and tree classification; physical based identification, landscape, and historical aspects; and recommendation for preservation of the heritage tree and landscape character strengthening on the De Groote Postweg Lane in Bogor City.

2.4. Recommendation
The proposed recommendations are formulated to be adopted by Bogor City Government for preservation of heritage tree and landscape character strengthening on the De Groote Postweg Lane in Bogor City. This recommendation is expected to be a contribution and alternatives for the government and others related agencies to the preservation of the heritage tree and management of the historical landscape and a source of information for the development of science related to heritage tree in the Bogor City.

3. Results and discussion

3.1. Tree species
Identified tree species were as many as of 281 trees belonging to 17 tree species included into 8 families, which are Burseraceae, Meliaceae, Fabaceae, Moraceae, Sapotaceae, Calopyllaceae, Annonaceae, and Bignoniaceae in table 1. The family which has the largest number of tree planted is
Burseraceae with 220 tree of kenari-nut tree (*Canarium commune* L.). The largest species number is Moraceae with 17 species, namely rubber fig (*Ficus elastica* Roxb.), white fig (*Ficus virens* Aiton), weeping fig (*Ficus benjamina* L.), common fig (*Ficus carica* L.), fiddle-leaf fig (*Ficus lyrata*), and *Ficus crassipes* F.M. Bailey.

| Family        | Tree amount | Species amount | Species                        | Common name                  |
|---------------|-------------|----------------|--------------------------------|-------------------------------|
| Burseraceae   | 220         | 1              | *Canarium commune* L.          | Kenari, Kenari-nut tree       |
| Meliaceae     | 23          | 2              | *Swietenia macrophylla* King.  | Big-leaf mahogany             |
|               |             |                | *Swietenia mahogani* Jacq.     | West indian mahogany          |
| Fabaceae      | 14          | 4              | *Maniltoa grandiiflora* Scheff. | Handkerchief tree             |
|               |             |                | *Delonix regia* Raf.           | Flamboyan, Flame tree         |
|               |             |                | *Tamarindus indica* L.         | Asam Jawa, Tamarind tree      |
|               |             |                | *Samanea saman*               | Rain tree                     |
| Moraceae      | 17          | 6              | *Ficus lyrata*                 | Fiddle-leaf fig               |
|               |             |                | *Ficus elastica* Roxb.         | Rubber fig                    |
|               |             |                | *Ficus virens* Aiton           | White fig                     |
|               |             |                | *Ficus benjamina* L.           | Weeping fig                   |
|               |             |                | *Ficus crassipes* F.M. Bailey  | *Ficus crassipes*             |
|               |             |                | *Ficus carica* L.              | Common fig                    |
| Sapotaceae    | 3           | 1              | *Mimusops elengi* L.           | Tanjung, Bullet wood          |
| Calophyllaceae| 2           | 1              | *Calophyllum inophyllum*       | Nyamplung, Borneo mahogany    |
| Annonaceae    | 1           | 1              | *Cananga odorata*              | Kenanga, Cananga tree         |
| Bignoniaceae  | 1           | 1              | *Spathodea campanulata*        | Kecrutan, African Tulip Tree   |

The identified canopy form consists of columnar, conical, dome, rounded, and spreading forms. The canopy shape is dominated by 181 tree columnar forms of kenari-nut tree species (*Canarium commune* L.). The other forms of canopy consist of 1 conical tree, 1 dome tree, 10 rounded trees, and 75 spreading trees. Rooting from identified trees was divided into two, 92.53% (263 trees) of banir root and 17.47% (40 trees) of tunjang root. Leaf shape of identified tree species consisted of Oblongus 88.26% (248 trees) and Ovatus 11.74% (33 trees). The shape of canopy, rooting, and leaf shape have an effect on the architectural function and ecological excellence of the heritage tree as the roadside trees.

3.2. **Tree age**

Tree age calculation using age estimation method and resulted in the tree age estimation range. The classification of the estimated range of tree age is adjusted to the development period of Bogor City. The Bogor development are categorized Colonial Period I (1600-1754), Colonial Period II (1754-1845), Colonial Period III (1845-1904), Colonial Period IV (1917-1930), and Pre-Post Independence Period (1930-1960). The result showed that kenari-nut tree (*Canarium commune* L.) dominating each age estimation range as presented in table 2. The number of kenari-nut trees in the estimated age range of 50-75 years as many as 80 trees, the estimated age range of 75-100 years as many as 62 trees, the estimated age range of 100-200 years as many as 71 trees, and the estimated age range of > 200 years as many as 7 trees as presented in figure 2 – figure 6. Trees with estimated ranges of over 200 years are dominated by the Moraceae family consisting of white fig (*Ficus virens* Aiton), weeping fig (*Ficus benjamina* L.), rubber fig (*Ficus elastica* Roxb.), and *Ficus crassipes* (*Ficus crassipes* F.M. Bailey).
Figure 2. Dissemination map of heritage tree on the 1st transect (Ahmad Yani Street).
Figure 3. Dissemination map of heritage tree on the 2nd transect (Ahmad Yani Street).
Figure 4. Dissemination map of heritage tree on the 3rd transect (Jendral Sudirman Street).
Figure 5. Dissemination map of heritage tree on the 4th transect (Ir. H. Juanda Street).
Figure 6. Dissemination map of heritage tree on the 5th and 6th transect (Ir. H. Juanda Street and Surya Kencana Street).
Table 2. Estimated age range and estimated planting time in Bogor City.

| Estimated age range (year) | Estimated planting time (period) | Tree amount | Information |
|----------------------------|----------------------------------|-------------|-------------|
| 50-75                      | Pre-Post Independence            | 100         | 1 F. benjamina L. 6 S. macrophylla King. |
|                            |                                  |             | 1 F. lyrata 8 M. grandiflora Scheff. |
|                            |                                  |             | 1 C. commune L. 3 M. elengi L. |
|                            |                                  |             | 1 C. inophyllum |
| 75-100                     | Colonial IV                      | 72          | 1 F. carica L. 62 C. commune L. |
|                            |                                  |             | 1 F. benjamina L. 5 S. macrophylla King. |
|                            |                                  |             | 1 F. elastica Roxb. 1 M. grandiflora Scheff. |
|                            |                                  |             | 1 D. regia Raf. |
| 100-200                    | Colonial III                    | 88          | 1 T. indica L. 1 S. saman |
|                            | Colonial II                     | 71          | 3 F. virens Aiton 7 C. commune L. |
|                            |                                  |             | 3 F. benjamina L. 7 S. macrophylla King. |
|                            |                                  |             | 1 S. campanulata 3 S. mahogani Jacq. |
|                            |                                  |             | 71 C. commune L. 1 C. inophyllum |
| >200                       | Colonial II                     | 21          | 3 F. virens Aiton 7 C. commune L. |
|                            | Colonial I                      |             | 4 F. benjamina L. 2 S. saman |
|                            |                                  |             | 1 F. elastica Roxb. 2 S. macrophylla King. |
|                            |                                  |             | 1 F. crassipes F.M. 1 M. elengi L. |

3.3. Historical value and period

Based on the estimation of age, trees on the De Groote Postweg Lane in Bogor City were planted during the colonial period of construction of the De Groote Postweg Lane in Bogor City until the pre-post-independence era. From several historical studies, Bogor City entered into the colonial period I (1600-1754), the colonial period II (1754-1845), the colonial period III (1845-1904), and the colonial period IV (1917-1930), and the pre-post independence period (1930-1960). The largest number of kenari-nut trees (Canarium commune L.) planted during the colonial period II and the colonial period III of 71 trees as well as in the pre-post independence period of 80 trees.

It is alleged that the Dutch colonial government already has a "garden city" city order using a roadside tree with a road guide function. Species of trees planted as road guide functions are kenari-nut trees (Canarium commute L.) whereas other species may be only in certain places or parts that do not belong to roadside trees. According Purnamasari [12], in the 1970s, Bogor City had earned the nickname as the City of Kenari-nut. It is alleged that the dominance of kenari-nut trees on several streets of Bogor City is a replication of the planting of kenari-nut trees located on Jalan Kenari, Bogor Botanical Gardens in the colonial period. Kenari-nut trees contained in Jalan Kenari, Bogor Botanical Garden planted by Johannes Elias Teysman in 1896 and estimated the age of the kenari-nut is already 120 years.

Kenari-nut tree (Canarium commute L.) with estimated age around 50-75 years, 75-100 years, and 100-200 years old were commonly found in Ahmad Yani Street, while above 200 years old commonly found in Ir. H. Juanda Street. Based on the important value of kenari-nut tree (Canarium commute L.), Bogor City Government intends to preserve and maintain the existence kenari-nut tree (Canarium commute L.) by applying City Mayor Decree of Bogor No. 520/SK.219-EKON/1995 on the Preservation of Flora and Fauna of Bogor, Kenari and Deer. Based on the data recapitulation of trees by the Sanitation and Garden Agency of Bogor City, it is known that once planted in 1998, 1999, 2000, and 2001.

3.4. Tree health

Based on observations by FHM method with 10 types of damage in which the assessment is recorded based on location, type, and severity class, we then calculated the index value of damage based on code and weights of damage index value (NIK) to determine health class of tree. The grade level of
tree health on the De Groote Postweg Lane is categorized into five levels ie, healthy without damage, healthy with damage, light damage, moderate damage, and severe damage.

Trees category listed were healthy without damage by 25.26% (71 trees) and trees with damage of 74.74% (210 trees) out of a total of 281 trees observed. As many as 210 trees with damage included healthy trees with damage of 60.49% (170 trees), light damage rate of 12.81% (36 trees), moderate damage rate of 1.42% (4 trees). The tree species that dominate all levels of damage is the kenari-nut tree (Canarium commune L.) with the most damage level is healthy with 53.02% damage (149 trees). The age range of most found trees that have damage is at the age range of 100-200 years of 31.67% (89 trees). The dominant types of damage were 35.69% overfoot (91 cases of damage), open wounds 21.96% (56 cases of damage), and broken or dead branch 13.73% (35 cases of damage). The most damaged parts of the tree are the lower stem and upper trunk 37.25% (95 cases of damage), 30.20% lower trunk (77 damage cases), and the upper stem 13.73 (35 cases of damage).

3.5. Growing environment
The growing environment of the heritage tree is analyzed according to the parameters based on the Tree Planting Guidance on Road Network Systems (Hidayat [9] and Utami [10]). The growing environmental parameters consisted of tree plant spacing with pavement of at least 3 m, spacing of the planting point, closing of street lamp emission, no damage to road structure, and branching. Local native plants are the best species selection based on the ecological aspects to be planted on the roadside. The origin of the tree is also noticed because the original vegetation type is preferred to the types of native animals (Whitten [13] and Idilfitri [14]). The value of the growing environment is the accumulation of the value of the five supporting parameters that have been obtained scoring results in figure 7.

The results showed that bad growing environment is about 0.36% (1 tree), less good growing environment is about 9.61% (27 trees), good growing environment is about 64.77% (182 trees), and excellent growing environment is about 25.27% (71 trees). Heritage tree with good and excellent environment found in in 1st and 2nd transects. In 1st transect the good growing environmental condition is 23.13% (65 trees) and excellent condition is 4.63% (13 trees). In 2nd transect good growing environmental conditions is 23.84% (67 trees) and excellent conditions is 8.90% (25 trees). Sufficient growing environments in 1st and 2nd transects on Ahmad Yani Road as primary arterial roads are supported by a sufficiently wide growing space on the plant path in the road's benefit space.

Growing environment conditions in the 3rd transect was for 11.74% (33 trees) consisted of good condition of 3.91% (11 trees) and excellent condition of 7.83% (22 trees). Growing environment conditions in the 4th transect was for 13.17% (37 trees) consisted of poor condition of 0.36% (1 tree), good condition of 11.39% (32 trees), and excellent condition of 1.42 % (4 trees). Growing environment conditions in the 5th transect was for 4.98% (13 trees) consisted of poor conditions of 0.36% (1 tree), good condition of 2.14% (6 trees), and excellent conditions of 2.49 % (7 trees). Growing environment conditions in 6th transect was only a bad condition of 0.36% (1 tree).

3.6. Ecological excellence
The ecological excellence of the heritage tree in the analysis using Key Performance Index with the parameters according to the Tree Planting Guidance on the Road Network Systems. The parameters of ecological excellence consist of steering, retaining rainfall and erosion, glare barriers, noise absorbers,
pollutant reducers, and wildlife habitats. The value of ecological excellence is the accumulation of the total value of six parameters generated from the scores of each transect and determined the comparison of ecological excellence. The value of ecological excellence obtained is as follows: 0% (0 trees) = bad, 5.69% (16 trees) = less good, 71.17% (200 trees) = good, and 23.13% (65 trees) = excellent as described in figure 8.

**Figure 8.** Ecological excellence values.

Steering parameters with the best values in the 2nd transect are due to the fact that there are many trees with physical barriers function with a total value of 39.1% consisting of excellent 37.72% (106 trees) and 1.42% good (4 trees). The best rainfall and erosion rate parameters in the 2nd transect are due to existence of high density trees capable of reducing the effects of falling rainwater with a total value of 39% consisting of 21.35% excellent (60 trees), 11.03% good (31 trees), 6.40% less good (18 trees), and 0.71% bad (2 trees). The glare barrier parameters with the best values in transect 2 were due to high tree density and intertwined tree-to-square hexagons with a total value of 40% consisting of 9.60% excellent (27 trees), 27.75% good (78 trees), and 1.77% less good (5 trees). The best noise absorbing parameters in 2nd transect are due to high density and tight leaf mass, large rod and branch structures, and light leaf and leafy leaves produce a good soundproofing with a total value of 40% comprising 27.04% excellent (76 tree), 10.67% good (30 trees), and 1.77% less good (5 trees).

The pollutant reducing parameter on the 2nd transect is due to high tree density, many trees with coarse surface texture, moderate leaf margin, and relatively moderate spacing produce good catchment pollutants with a total value of 39% consisting of 14.23% excellent (40 trees), 20.64% good (58 trees), and 4.62% less good (13 trees). Based on Lailati [15], type of plant that has the highest sink ability of carbon dioxide is kenari-nut tree (*Canarium commune* L.) of 12,638.453 grams / tree / hour. The best wildlife habitat parameters in 2nd transect are due to the many nectar and flowering trees, varied fruit sizes, and fruit shells of varying thickness creating environments for shelter, breeding, and interacting with one another from the animals. The total parameters on transect 2 with values of 40% consisting of 1.42% excellent (4 trees), 9.60% good (27 trees), 8.89% less good (25 trees), and 19.57% bad (55 trees).

### 3.7. Architectural function

Based on the observation, number of tree as visual control was 13 trees, as physical barriers was 281 trees, as climate control was 281 trees, as erosion control was 41 trees, and as aesthetic values was 26 trees. Architectural function comparison in all transect shown in table 3.

**Table 3.** Comparison of architectural function based on transects.

| Architectural function | 1st transect | 2nd transect | 3rd transect | 4th transect | 5th transect | 6th transect |
|------------------------|--------------|--------------|--------------|--------------|--------------|--------------|
| Visual control         | 0.00         | 0.71         | 3.91         | 0.00         | 0.00         | 0.00         |
| Physical barriers      | 30.25        | 39.50        | 11.74        | 13.17        | 4.98         | 0.36         |
| Climate control        | 30.25        | 39.50        | 11.74        | 13.17        | 4.98         | 0.36         |
| Erosion control        | 3.91         | 2.14         | 5.69         | 2.49         | 0.36         | 0.00         |
| Aesthetics values      | 3.20         | 0.00         | 4.27         | 1.78         | 0.00         | 0.00         |

The best visual control function in the 3rd transect about 3.91% (11 trees) in Jendral Sudirman street was attributed to the state’s vital object there are Zeni Education Center, PETA Museum, and Kodim 0606 Bogor Headquarters. The best physical barriers function in the 2nd transect about 39.50% (111
trees) and 1st transect about 30.25% (85 trees) in Ahmad Yani street due to trees restricting the traffic by drainage and sidewalks in the space of benefit street (RUMIJA). The best climate control function in the 2nd transect about 39.50% (111 trees) and the 1st transect about 30.25% (85 trees) in Ahmad Yani street due to the number of trees with high tree density and intertwining canopy resulting in space formation under a canopy with a cooler microclimate. The best erosion control function in the 3rd transect about 5.69% (16 trees) in Jendral Sudirman street due to the presence of large trees with root distribution capable of binding solid material on Taman Peranginan which is directly adjacent to Ciliwung river. The best aesthetics values function in the 3rd transect about 4.27% (12 trees) in Jendral Sudirman street is due to the existence of large trees on Taman Peranginan with dome or spreading canopy shape giving unique impression. Aesthetic value is also added with the existence of epiphytic plants that grow on the surface of the tree trunk and the presence of animals such as scarlet-header flowerpecker (*Dicaeum trochileum*), sooty headed bulbul (*Pycnonotus aurigaster*), and spotted dove (*Streptopelia chinensis*).

### 3.8. Roadside tree suitability

Roadside tree suitability was analyzed using *Tree Planting Guidance on Road Network Systems*. The analysis result was combination of tree health, growing environment, ecological excellence, and architectural functions. Based on the observation result, there were trees with less suitable status of 0.36% (1 tree), the suitable status of 16.01% (45 trees), and very suitable status of 83.62% (235 trees) in figure 9. The suitability of the roadside tree is also influenced by the shape of crown, branching, rooting, leaves, flowers, and fruit. The suitability of the roadside trees is influenced by the columnar canopy shape with branches leading upstream and upwards so as to maximize the streetlight emission so as to reduce the risk of accidents. Roots that do not damage the structure of the road, the leaves are not easily fall out, flowers and fruits that are not easily fall into supporters of suitability of the roadside trees.

![Figure 9. Roadside tree suitability level.](image)

The suitability of the roadside trees on the 1st transect is about 30.25% (85 trees) which includes the suitable status of 4.98% (14 trees) and the very suitable status of 25.27% (71 trees). The suitability of the roadside trees in the 2nd transect is about 39.50% (111 trees) which included the suitable status 9.25% (26 trees) and the very suitable status of 30.25% (85 trees). The suitability of the roadside trees in the 3rd transect is about 11.74% (33 trees) which only suitable status. The suitability of the roadside trees in the 4th transect is about 4.98% (14 trees) which the suitable status of 0.71% (2 trees) and the very suitable status of 4.27% (12 trees). The suitability of the roadside trees in the 5th transect is about 0.36% (1 tree) which only includes less suitable status.

The high suitability of the roadside trees in the 1st transect and the 2nd transect was supported by high ecological excellence as well as high architectural functions. The ecological excellence of the 1st transect and the 2nd transect consist of guide trees, obstructions to glare, rainwater rate retention and erosion, noise absorbers, pollutant reducers, and animal habitats. While the existing architectural functions consist of visual control, physical bariers, climate control, erosion control, and functions as aesthetics values.

### 3.9. Recommendation

Based on result and discussion, kenari-nut tree (*Canarium commune* L.) is considered as heritage tree because it was commonly encountered along *De Groote Postweg* Lane which consisted of 220 trees.
and other identified species. The recommendation for Bogor City Government for preservation of heritage tree and landscape character strengthening could be divided in three parts, namely heritage tree maintenance, improvement of growing environment, and landscape characteristic strengthening.

For the heritage tree maintenance, all trees especially kenari-nut tree \((Canarium commune \text{ L.})\) is maintained based on type and damage level. A 100-200 and >200 years old tree can be maintained with intensive maintenance to keep the well-being and decrease the danger for people under it.

The improvement of growing environment can be implemented in unfavorable condition especially to the root structure, root growth space, street structure so the growth of the root won’t be hindered and also the root won’t damage street structure. Planting same kind of tree which is kenari-nut tree \((Canarium commune \text{ L.})\) in empty space can be a follow-up of the improvement of growing environment. This is important as a form of kenari-nut tree \((Canarium commune \text{ L.})\) dominancy along De Groote Postweg Lane in Bogor City.

Landscape characteristic strengthening along De Groote Postweg Lane in Bogor City can use interpretation board, another element which helps to inform the heritage tree, and heritage landscape nuance. Interpretation board should show brief information about tree species, tree age, and historical value of tree suspected as heritage tree. Another element which can help to identify heritage tree can be a plaque or fence. Using lamp at the base of tree trunk will give heritage nuance of heritage tree in Ahmad Yani street, Jendral Sudirman street and Ir.H. Juanda street.

4. Conclusion

Trees estimated as heritage tree on De Groote Postweg Lane along 6.58 km in Bogor City from Ahmad Yani street, Jendral Sudirman street, Ir.H. Juanda street, and Surya Kencana street was 281 trees from 17 tree species into 8 families. The total tree number consisted of 196 trees in Ahmad Yani street, 33 trees in Jendral Sudirman street, 52 trees in Ir.H. Juanda street, and no tree in Surya Kencana street. The largest number of tree suspected as heritage tree was kenari-nut tree \((Canarium commune \text{ L.})\) which was 220 trees. There were 174 kenari-nut tree \((Canarium commune \text{ L.})\) in Ahmad Yani street, 6 in Jendral Sudirman street, and 40 in Ir.H. Juanda street.

Total number of kenari-nut tree species in estimated age of 50-70 years old was 80 trees. Kenari-nut trees in estimated age of 75-100 years old were 62 trees, while Kenari-nut trees in estimated age of 100-200 years old were 71 trees. In particular, Kenari-nut trees with estimated age >200 years old were 7 trees. For estimated age of >200 years old, Moraceae family was found as the largest number of tree consisting of white fig \((Ficus virens \text{ Aiton})\), weeping fig \((Ficus benjamina \text{ L.})\), rubber fig \((Ficus elastic \text{ Roxb.})\), and \(Ficus crisisipes\) F.M. Bailey. Recommendation proposed for preservation of heritage tree and landscape character strengthening consisted of three points, namely: heritage tree maintenance, improvement of growing environment, and landscape characteristic strengthening.

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