

Tree management at Boulevard landscape of Alam Sutera Serpong, a new city area in Tangerang

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Abstract. Alam Sutera is an integrated area in Serpong, Tangerang. Alam Sutera has various of green open space areas. One of the greenery open spaces is streetscape, which consists of many trees species with various characters, shape, age and specific maintenance. The objective of this paper were to carry out tree road analysis and to describe the evaluation results on tree management including recommendation for tree management. The International Tress Evaluation Method (ISTEM) was used as assessment approach in order to know the trees valuation. Some physical trees characters such as diameter of the breast height (dBH), trees quality condition, tree class and constanta of price unit were considered in this valuation. Based on the results, a lot of tree pests, diseases and a bit mechanical damage were found in boulevard landscape. Tree pests and diseases such as termites, caterpillars, caterpillars sac, aphids, ants, fungi, powdery mildew, leaf rust and stem cancer were controlled mechanically, physicall, biological, quarantine, cultivation techniques and by using an environmental friendly chemical pesticide. On the other hand, trees that suffered mechanical damage due to vandalism, scratches, cuts, and broken branches should be maintained with proper management. The physical damage affected the visual appearance and aesthetics of the road trees.

1. Introduction

Alam Sutera is a mixed-use development with an area of 818.23 ha in Serpong, Tangerang. This area has been developed since 1994. Nowadays, it has become an established, dynamic and the most interesting city in western Jakarta. The city consists of residential areas as well as commercial areas integrated with other supporting facilities. A variety of premium facilities ranging from education, entertainment, health, to shopping centers are available in this area [1].

The new city of Alam Sutera has a green open space in various forms, one of which is the street landscape. Trees have four main functions, i.e. (1) to modify the temperature and humidity, (2) to prevent soil erosion, hold water, muffle noise, reduce air pollution, reduce sun glare and reflect the light, (3) as architectural function, and (4) as environmental beauty [2]. Therefore, tree must be managed to produce good road corridor performance. Maintenance of trees is a landscape management activity that aims to maintain the landscape with all existing facilities in it so that the physical condition of the area is still good and can maintain the state in accordance with the original design [3] and [4]. Large tree sizes, tree age, and natural conditions such as wind and heavy rain often cause problems that threaten the safety of the environment. On the other hand, shade trees in urban areas also have material and immaterial values. International Shading Tress Evaluation Method (ISTEM) is one method to know the value of urban tree. The value can also be used for the estimation of insurance premiums, the contribution of property value, the amount of tax if there is falling of



trees, and so on. Therefore, the objectives of this paper were to: 1) communicate the results of tree road analysis on the boulevard landscape by ISTEM method, 2) to describe the evaluation result of tree management, and 3) submit the recommendation for tree management in Kota Baru Alam Sutera.

2. Method

2.1 Location and time of research

This research was conducted in Kota Baru Alam Sutera, Serpong, Tangerang, on boulevard landscape (figure 1). The study was conducted from February 2015 to June 2015.

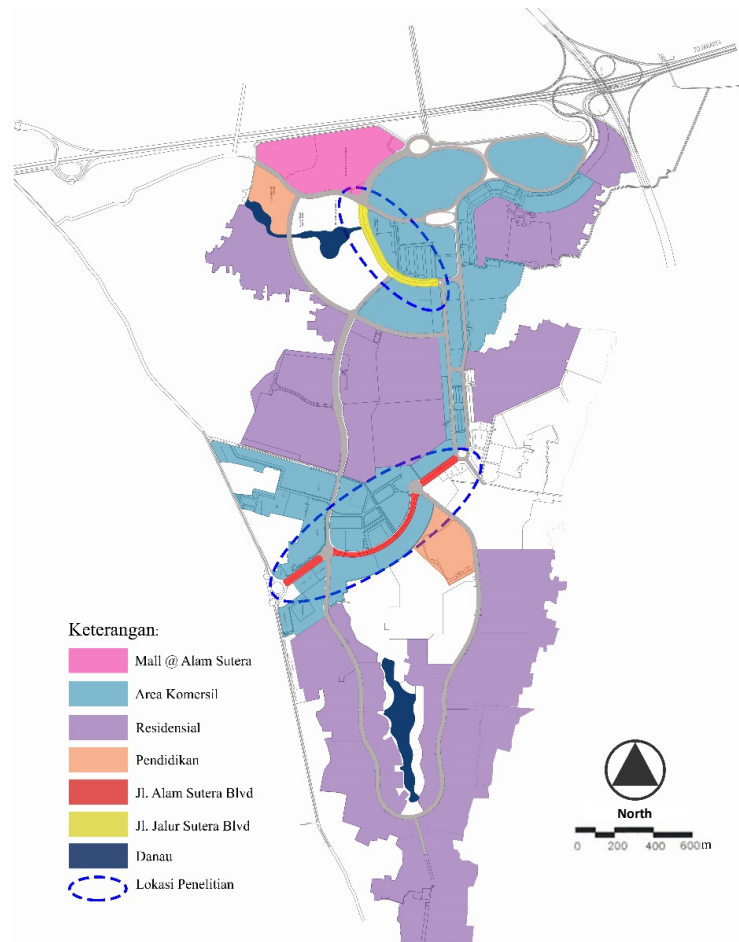


Figure 1. Map of study site of new city of Alam Sutera Serpong Tangerang. Source: [1].

2.2 Tools and materials

The equipment was used in this research are assorted hardware, such as survey sheet, digital camera, GPS, DBH meter, clinometer and roll meter. Meanwhile, the software applied were Adobe Photoshop, Google Earth, and MS Excel. Materials in this research was a detailed map of study site.

2.3 Research methods

2.3.1 Road tree analysis. Road trees in the observed landscape were *Samanea saman* (summed up to 122 trees), which are located at Alam Sutera Boulevard and Silk Road Boulevard. Measurements taken were: 1) tree radius at chest height using DBH meter, 2) observation of physical condition and damage of tree, 3) interview to Estate Management of Alam Sutera. The data were used to determine the value of trees calculation by the ISTEM formula using equation 1 as followed:

$$ISTEM = \pi \times r^2 \times \% Tree Class \times \% Tree Condition \times 40 USD \quad (1)$$

Remarks: $\pi = 3.14$

r^2 = tree trunk radius at breast height (inchi)

% Tree Class = Class1 (100%), Class2 (80%), Class3 (60%), Class4 (40%), and Class5 (20%)

% Tree Condition = Accumulated conditions on the stem, root base, leaf, branches, mechanical damage, canopy cover percentage (0-100%)

Tree Data Collection by inventory and physical measurement of trees is done to determine the type and number of trees studied. The physical data of the tree is required, as follows:

Diameter at the Breast Height (DBH): The diameter of the trunk was measured at breast height. From the data of tree trunk diameters obtained in the field, it could be known also the radius of tree trunks that would contribute to the ISTEM formula.

Damage caused by plant pests and diseases (table 1): a. Damage to pests and diseases at root at soil surface and stem; b. Damage to pests and plant diseases on branches and leaves.

Table 1. Pest-Disease damage at root and stem.

No	Pest and Disease Damage		Score
	<u>Roots and Stems</u>	<u>Branches and Leaves</u>	
1	There is no damage to pests and diseases	There is no damage to pests and diseases	0
2	The existence of pest and disease damage	The existence of pest and disease damage	1
3	The presence of fungi and parasites	The presence of fungi and parasites	2
4	Stems dry/weathered; roots dry/weathered	Chlorosis	3
5	Root rot; rotten roots	Necrosis	4
6	Cave/porous visible	Banked branching	5

Source: [5].

Mechanical Damage: Damage to trees caused by contact with physical objects e.g. graffiti, friction, scratches, crashes, etc. that could cause visual injury and damage to the tree. The observation result was weighted on score 0-5 (table 2).

Table 2. Mechanical damages to trees.

No	Mechanical Damages	Score
1	No mechanical damage	0
2	Vandalism	1
3	Cuts, incisions	2
4	Scratches	3
5	Broken branches	4
6	Thunder hazard, vehicle crashed	5

Source: [5].

Based on the assessment, the damage intensity was determined in 5 damage scales, i.e.: damage intensity 0 - 20% (0.2); damage intensity 21 - 40% (0.4); damage intensity 41 - 60% (0.6); damage intensity 61 - 80% (0.8); and damage intensity 81 - 100% (1.0). The intensities of damage were categorized into the following ratings: Rank 1 (none): attack 0% <damage <15%; Rank 2 (little): attack 15% <damage <30%; Rank 3 (many): 30% offensive <damage <50%; and Rank 4 (very many): damage attack > 50%.

2.3.2 Tree management evaluation. The evaluation of tree management is conducted by determining the tree class. The tree class was determined based on the characteristics of the tree that have been established by Shading Trees Evaluation Committee. Tree management evaluation was assessed by ISTEM method.

2.3.3 Establishment of tree management recommendations. The preparation of this tree management recommendation referred to the maintenance of the park [3]. In the maintenance of the park terms of

ideal maintenance and physical maintenance were known. Ideal maintenance was maintenance that referred to the original purpose and design. Therefore, in a certain period of time it was needed to be evaluated. While the physical maintenance of the park included work for beauty, amenity, comfort, and park security.

3. Results and discussion

3.1 Analysis of the road tree

Based on observations there were 122 trees of *Samanea Saman* (rain trees) in Alam Sutera Boulevard and Jalur Sutera Boulevard. Seventy trees were found on the median as well as the right and left side of the road of Alam Sutera Boulevard, then there were 52 trees on the road median of Jalur Sutera Boulevard.

3.2 Alam Sutera Boulevard

Seventy trees were observed in Alam Sutera Boulevard distributed 14 trees at the right and left side of the road, and 15 trees at the median road front of main gate of Alam Sutera. Twenty two trees were in front of Living World, and 19 trees were on the median road in the front of Alam Sutera Sport Center (figure 2 and figure 3). All those trees were identified in order to know their level of pest-disease destruction and mechanical damage.

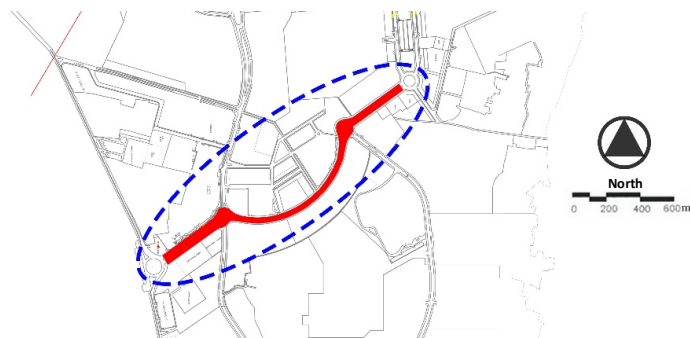


Figure 2. Location map of Alam Sutera Boulevard.



Figure 3. Landscape and road trees condition of Alam Sutera Boulevard.

The percentage of tree damages due to pest and diseases was classified as "too many" in Alam Sutera Boulevard (table 3) having the 4th damage rank (73%). Mechanical damage was ranked the 2nd with a value of 50%. Based on this, the condition of the tree in Alam Sutera Boulevard was classified in the 4th rank with a total damage of 100% (damage condition of the tree "very many"). Road tree encountered here was only 1 species, which was monoculture of *Samanea saman*, whereas, for landscape sustainability and conservation of the urban landscape environment, it should have been supported by urban biodiversity. Ten tree species were the species most often found at the road side green belt in Jakarta, i.e. *Swietenia macrophylla*, *Pterocarpus indicus*, *Mimusops elengi*, *Polyalthya fragrans*, *Cerbera manghas*, *Ficus benjamina*, *Dialium indum*, *Ryostonea regia*, *Polyalthya longifolia*, and *Bauhinia purpurea* [6]. The high diversity of tree species could reduce outbreak diseases, as different types of plants endured different pest and disease attacks.

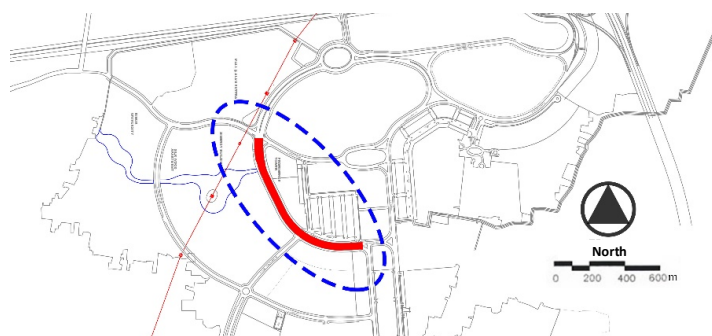
Table 3. Ranking of tree damages in Alam Sutera Boulevard

Alam Sutera Boulevard	Pest & Disease Damage Rank				Mechanical Damage Rank				Total Damage Rank			
	1	2	3	4	1	2	3	4	1	2	3	4
Right side of road	0	7	5	2	2	9	4	0	2	16	9	2
Left side of road	0	0	2	13	1	10	3	0	1	10	5	13
Median of road	0	0	5	36	19	16	6	0	19	16	11	55
Total	0	7	12	51	22	35	13	0	22	42	25	70
%	0	10	17	73	31	50	19	0	31	60	36	100

Remarks: Rank 1 (none): attack 0% <damage <15%; Rank 2 (little): attack 15% <damage <30%; Rank 3 (many): 30% offensive <damage <50%; and Rank 4 (too many): damage attack > 50%.

3.3 Jalur Sutera Boulevard

The observed tree of Jalur Sutera Boulevard was located at a road median with a total of 52 trees (figure 4). Trees were located along the road to Synergy Building. The general condition of these trees were younger than those in the Alam Sutera Boulevard (figure 5).

**Figure 4.** Location map of Jalur Sutera Boulevard.**Figure 5.** Landscape and road trees condition of Jalur Sutera Boulevard.

Percentages of pest and disease damage to trees on the Jalur Sutera Boulevard were numerous (table 4). It was investigated that pest and disease damage were in the 4th rank (46%). Mechanical damage was ranked 2nd (77%). Based on this condition, the tree on the Jalur Sutera Boulevard was ranked 2nd (98%). This indicated that the trees in the Jalur Sutera Boulevard were in a state of minimal damage. It was known that *Samanea saman* was one of the introduced tree species. The use of native or indigenous species is encouraged in urban greening programs in order to maintain ex situ species conservation. Furthermore, native species are inherently well suited to their original habitat [6].

3.4 Evaluation of tree management

This rain tree (*Samanea saman*) included as a shading tree with a grade value of 80%, the tree canopy had dome shape, and high capacity for shading. The criterion of tree condition observed was the type of adult tree (above 5 years old), which had relatively large tree trunk size as determined by the Shade Tree Evaluation Committee. The size of the tree trunk determined the shade size of the tree, therefore it got the high ISTEM value. The result of this calculation could be used as insurance assessment or

just to know how big asset of a city. The resulting value affected the condition of the tree, where the more severe the damage to the smaller the resulting value of the tree .

Table 4. Ranking of tree damages on the Jalur Sutera Boulevard.

Jalur Sutera Boulevard	Pest & Disease Damage Rank				Mechanical Damage Rank				Total Damage Rank			
	1	2	3	4	1	2	3	4	1	2	3	4
Road Median	2	11	15	24	11	40	1	0	13	51	16	24
Total	2	11	15	24	11	40	1	0	13	51	16	24
%	4	21	29	46	21	77	2	0	25	98	31	46

Remarks: Rank 1 (none): attack 0% <damage <15%; Rank 2 (little): attack 15% <damage <30%; Rank 3 (many): 30% offensive <damage <50%; and Rank 4 (very many): damage attack > 50%.

The highest value of ISTEM at Alam Sutera Boulevard was the tree number 0668, which was Rp. 58.025.729.321, - with 334 cm perimeter stems, 106.3 cm DBH, and 20,920 inch tree radius. The lowest value was in the tree number 0646 valued Rp. 4.607.655.869, -. The trunk of this tree was branched so that it got around the stem 1 and the stem 2, with length each was 292 cm and 44.2 cm, respectively, where their DBH stems were 29.3 cm and 14.1 cm, respectively. The tree trunk radius was calculated from tree trunk with the largest DBH, and the result was 5,768 inches.

The largest ISTEM value in the Jalur Sutera Boulevard was tree number 1008 (Rp. 6.124.422.382, -). This tree had two branches then got perimeter of stem 1 and stem 2 with length each was 63 cm and 85 cm, respectively. The perimeter of the main stem was 109 cm. DBH was calculated on the main stem which summed up to 34,681 cm, and its radius was 6,827 inches. The lowest value was in tree number 0986 with perimeter of tree trunk 49 cm, DBH 8.909 cm and radius 1.754 inches.

The ISTEM value was converted from USD to IDR. The greater the ISTEM value meant the better condition of the tree. In the variable assessment of the condition of the tree, it was not much found pest-disease damage and mechanical damage. On the other hand, the smaller the ISTEM value meant the worse condition of the tree is not good. In the variable assessment of the condition of the tree, it was found many pests, disease damages and mechanical damages. From observation on 122 rain trees, entirely required maintenance and management to minimize plant's pests, diseases and mechanical damages were investigated. The ecological value of the tree could be predicted by using dynamic model and based on ISTEM [7].

If associated with landscape services, it was known that trees with high ISTEM values are owned by trees with large trunk diameters, excellent tree quality and condition, including into the ideal shade tree classification. Thus the tree had the potency to have a high value of tree carbon stock. Urban forest landscape studies in addition to their functions as biodiversity conservation, hydrology and aesthetics also have a share and function as carbon stock [8].

3.5 Tree management recommendations

Some treatment recommendations for each part of the damaged tree were, as follows:

Pruning: Types of tree pruning could be distinguished by their purposes, i.e. pruning for tree health, tree performance, and user safety [3]. To avoid damage to the bark, the method of pruning branches and tree trunks should be held properly (figure 6).

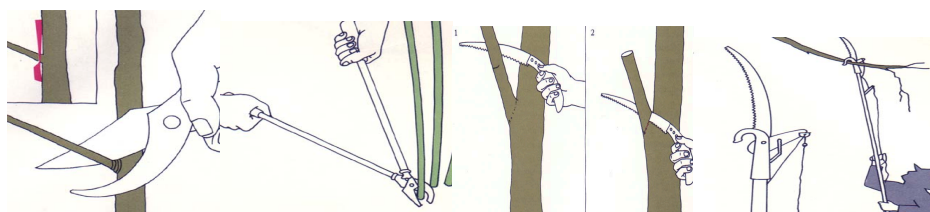


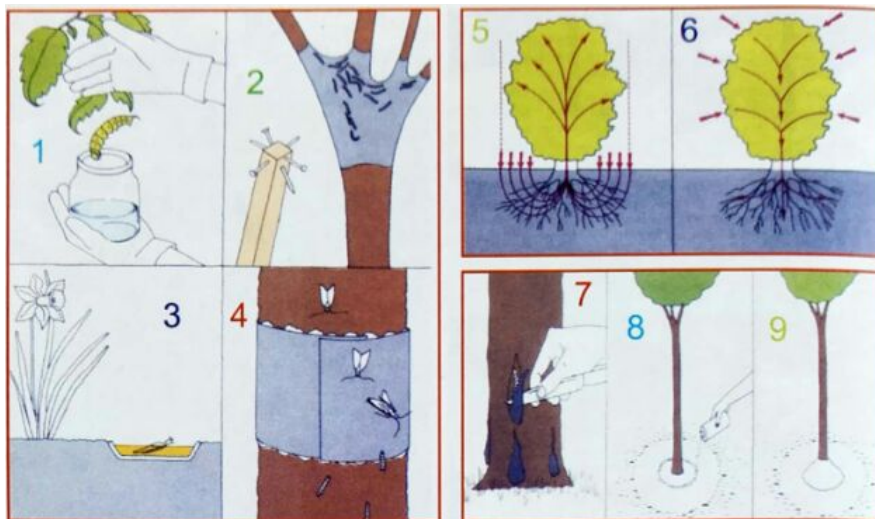
Figure 6. Tree branches and stems pruning methods. Source: [3]

Proper pruning treatment, both on and after, can increase the strength of branch growth. Pruning as a disease control is done by cutting the stem is stricken up to 10 cm below the affected or infected. Then, the cut wound is smeared with 70% ethyl alcohol. Should be avoided pruning when the leaves

are still wet because parasitic organisms will be easy to develop [3]. All 122 trees require pruning due to the condition of the tree when observed to be damaged by pests and diseases and stems and dried branches.

3.6 Plant pests and diseases management

Pests and diseases can attack all parts of the plant, ranging from flowers, fruits, leaves, branching, stems, to the rooting. This damages the aesthetic appearance and can lead to death in the tree. Trees that need to be reduced are dead, harmful, coincident, disease-threatening and can threaten other trees or disrupt electricity and telephone lines. The ranking of damage caused by pests and diseases that require rapid handling was ranked 3rd and 4th, whereas damage attacks were numerous and very many. In the ranking there were a total of 102 trees with the highest number on Alam Sutera Boulevard as many as 63 trees and on Jalur Sutera Boulevard of 39 trees. Control of pests and diseases could be done mechanically, physically, biologically, through quarantine, cultivation techniques and chemicals by using pesticides. The control of pests and diseases on trees in Alam Sutera Boulevard can be done mechanically which is the easiest way. The trick is to take an attacking pest, then kill it with a hand or a certain tool, then remove the sick or damaged plant parts (figure 7). Physical control method can be done through stages as followed: (1) Manual take by hand; (2) Shut-down with a nail-striker; (3) Blocking with physical boundary traps; (4) Making of a trap that will be visited by insects; (5-6) Chemical way with rooting and spraying; (7) Cleaning the affected part of the insect; (8-9) The treatment of chemical pesticides by rooting.



Remarks: (1) hand manual; (2) nail-striker; (3) boundary traps; (4) insect trap cover; (5-6) Chemical way with rooting and spraying; (7) Cleaning the affected part of the insect; (8-9) The treatment of chemical pesticides by rooting.

Figure 7. Various ways of pest & disease controls. Source: [3]

3.7 Mechanical damage

Landscape beauty and cleanest are often disturbed by pollution due to human behavior, that is vandalism. The common forms of vandalism in the trees of Alam Sutera were graffiti, wounding tree bark, cutting trees or parts of trees, installing lights on tree trunks, nail and wire marks from banners or billboards. Based on the observed data there were 29 trees affected by vandalism. For that it needs to be prevented with the education in order to increase the awareness of community.

4. Conclusion

1. Analysis of road trees in the boulevard landscape by ISTEM method indicated that both of these pathways have pest and disease conditions at rank 4th (very many) and mechanical damage at rank 2nd (slightly).

2. The rain trees in Alam Sutera had different damage cases for each tree. Based on an evaluation of 122 trees it was known that all of them required further management action and some trees needed special attention.
3. Based on the recommendations produced, the management of the Trembesi tree mostly required pruning, pest and disease eradication and weeding weeds.

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