The damage trees study for a good and save roadside greenery planning in Surakarta City, Central Java

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Abstract. Purpose: This research question is 'how to plan a good and save the road side greenery in Surakarta?' The research objectives are: Identification of the trees characteristics (type and size); Identification level of the health trees, and Trees location. Methodology: This research used categorized methods by health of tree, that is: health, little damage, moderate damage and heavy damage. The research location at Slamet Riyadi street, Jenderal Sudirman street and Urip Sumohardjo street at Surakarta City. Results: This research has built a Tree Inventory Application, named SIPPOHON. Through SIPPOHON trees can be inventoried by the name, type and characteristics. Tree location is integrated in a global positioning system (GPS); The Polyalthia longifolia, Mangifera kemanga, Diospyros blancoi, Pterocarpus indicus, Erythrina, Manilkara kauki, Langerstroemia and Casuarina tend to be damaged or unhealth; Some forms of tree damage are caused by: hole and trunks hollow; mechanical damage (scratches and cuts at the tree until the cortex); the brittle stems caused by pest attacks; swelling of the stem; the dead of partial canopy; trees tilted into the electricity grid; and roots appear to the surface of land. Applications: The result of the research are an SIPPOHON application to manage the green roadside, especially: Treatment of pest are needed to prevent the spread of disease and Routine maintenance and monitor the tree condition.

1. Introduction
As one of the attributes the green city, green urban spaces are very important. Vegetation as the main component of green open space have a great contribution in controlling environmental quality. The presence of tree as green roadside is enrichen the pleasant environment for road users, absorb the pollution and produce oxygen. In addition, trees have physical properties to provide aesthetic values of shape, texture, colour, smell and other parts. Trees need a long time to produce all of that. To optimize these functions and benefits for formed the physical, ecological, social, and architectural comfort, the tree as green roadside need to be maintained continuously. The government should be set the good policies for manage the roadside trees, especially in logging activities. To logging the tree must have a good reason. Cutting down or logging the trees only be done if very forced.

Although all parties agree on the benefits of the trees, in the fact bargaining position of 'maintaining' the trees set at the bottom priority. Policy and development paradigms often promote the economic and social parameters and leave environmental sustainability. The argue if benefits of trees are difficult to measure, even visually less visible physically as a cause of ignoring the tree strategic value as explained above. Trees grow unhealthy, have no aesthetic
appearance, spread pests and diseases, tilt, and often falling over down the urban infrastructure, individual property (cars or houses) and even on people, causing casualties. In response to the safety first principle, some good trees are often cut down for reasons of anticipation or mitigation of typhoons.

This situation also happened in Surakarta city, Central Java. Based on information from Environment Office of Surakarta City, square of Surakarta city 44.04 km² and 12.74% from that are the public green open space. Several from that formed as green roadside. Many tree has planted green roadside with variation condition. The species, planting location, the age and heath of the tree are varied too. Some of the trees in not good health and nearly to fall down. The Environment Office of Surakarta City declared if it difficult to answer the request for tree felling on the roadside in a short time due to the absence of accurate data. Field checks are required to conduct research. In other hand, special conditions of tree such as unhealthy trees due to disease and pests are found in the field. This conditions make logging requests seem urgent. Based on this dilemma, the Environment Office of Surakarta City rise big data to descript the accurate tree conditions. Through this step, the logging (eradication) and maintenance of roadside trees can be carried out properly and right on target.

So, the formulation of this research question is 'how to build the database of trees roadside in Surakarta?' The research objectives are: (1) Identification of the trees characteristics (type and size); (2) Identification level of the health trees, and (3) Trees location. The expected of this activity is to produce a database of trees that is integrated through the development of spatial-based information systems. The development of this information system can be used to strengthen the database of trees in the Surakarta city as well as to monitor and prevent logging without rational consideration. Tree location marking is done using a global positioning system (GPS).

2. Methods
The study was conducted in 2017, used the SIPPOHON. Based on information from the Surakarta City Government on its official website, SIPPOHON is a web-based application that allows it to run on all Operating System platforms such as Microsoft Windows, Linux, and Apple Macintosh. As a database, SIPPOHON contains the existing state of the tree by name. The existing condition was recorded from the Tree Identify Card (Tree ID Card), which is an acrylic plate equipped with a QR code and attached to each tree. QR code contains data and information on name, physical description (tree diameter, canopy width, root and tree stand conditions) and tree health condition (healthy, light and moderate damage, and severely damaged or fallen). The development of tree conditions can be updated by the admin.

As an application, SIPPOHON has many benefits, including: (1) Regular monitoring; (2) Many tree identities and histories are stored. Accurate regular monitoring makes it easier to maintain and care for the tree. Adverse effects due to fallen trees can also be anticipated from an early, by giving a special colour to the tree’s ID card. Even road users can see a sign in the lower left corner of the tree ID card. There are three colours, namely red, yellow and green. Red means very prone to falling, yellow means it needs attention because it is prone to moderate or mild, and green means healthy. These colors make it easier for officers to do tree maintenance so that handling unhealthy trees does not always end in cutting.

The survey location based on the green roadside listed in Surakarta Mayor Regulation number 24 at year 2011 concerning Urban Forests and Green Roadside (Figure 2). Some of these roads are Slamet Riyadi street, Jenderal Sudirman street and Urip Sumohardjo street at Surakarta City. The total number of the trees are 2,753 trees: 2,198 trees at Slamet Riyadi street, 151 trees at Jendral Sudirman street, and 404 trees at Urip Sumoharjo street.

To identify the number and concession of trees in each location, data and information were collected through direct observation and identify the geographical using GPS (Geography
Information System). The physical condition of the tree observed by check the bottom of the roots (which are on the surface of the ground), stems, leaves, and branches. The physical condition assessment is based on 2 criteria, namely health and technical conditions in the form of slope of the trunk that has the potential to threaten the house, road, electricity network and mechanical damage. Observation of the physical condition of the tree is done descriptively based on visual conditions in the field. Physical observations of the tree include: (1) Tree names and types, (2) Trunk circles, (3) Tree height, (4) Canopy width, (5) Spacing between trees and (6) Tree Location coordinates. Tree location data is obtained through scanning the location of each tree using GPS GLONNAS type to see the location of coordinates in the form of UTM X and UTM Y as well as geographical coordinates. Recording data is processed using MapInfo Professional 11.0 / ArcGIS so that it can be mapped on a digital earth map.

The assessment of tree health level is based on the following indications. Tree categorized
as health or normal when the trees still carry out its physiological functions. Conversely, the trees are unhealthy if the trees are structurally damaged either in whole or in part. This condition is caused by the disease, pathogenic living organisms or physical environmental factors. The abiotic factors cause the tree damage are physical and chemical factors that make up the environment where the growth does not support the normal growth or development of forest trees, including temperature, humidity, climate, nutrients, water pollution, lack of oxygen and light. The trees damage occurred by the many factor, such as:

(i) Cancer. Symptoms of cancer showing by damage the form of swelling of the stem that extends to the top and bottom. The woody tissue on the swollen trunk generally becomes soft, brittle, cracked, and is often used for insect protection. Cancer may be caused by various agents but more often caused by fungus. In areas where the topography is sloping (bumpy) and a lot of wind, trees suffering from cancer of the trunk are easily broken and fallen.

(ii) Heart rot, fruit body and weathered further. Symptoms of these showing by the form of decay at the base of the stem, then accompanied by the presence of leaves in the canopy that turn yellow and dry. This condition caused by the death of tissue cells in plants. Death of plant tissue is usually preceded by a change in colour from green to yellow then to brown or reddish due to attack by pathogens. This damage is difficult to observe from the outside, but the emergence of the fruiting body is an advanced indicator of weathering caused by fungi.

(iii) Open wound is a wound or series of wounds that are shown by peeling off the skin. In this case the inside of the wood has opened and the next further weathering. Usually open wounds are caused by pruning wounds that cut into wood.

(iv) Resinosis and Gummosis. Resinosis is a discharge in the form of resin from the diseased part of the plant, and is called gummosis if it is gum. Occurs only if the trunk or branch is injured or injured until it hits the xylem and has a pathogen. This type of damage will make the tree sick because it loses a lot of sap and invites disease attacks.

(v) Dieback is type of damage where the death of a branch or branch from the end and extends to the cambium. Dieback is not necessarily the result of one factor such as the result of destructive organisms or a prolonged dry season, but because of the accumulation of a lack of nutrients that triggers the damaging organisms.

(vi) Broken or dead roots causes the illness. Insects and decaying bacteria usually occupy this part of the wound immediately. Eventually the tree becomes sick and damaged.

(vii) Loss of dominant tip or the death of shoots. The death of shoots are usually caused by weather, insects and diseases. The dead of shoots causes the growth of the trees not straight, shoot tissue becomes dry, brittle and rotten. The quality of growth are decreases. The death of shoots in generally causes by the damage to plant tissue or xylem blockage.

(viii) The damage of bud, leaf or shoots are the leafs eaten by insects or fungi attacked.

(ix) Changes in leaf colour started from brownish yellow leaf spot, reddish brown to dark brown. If there are several spots in one leaf, patches can coalesce to form a large patch area. These patches can develop quickly to form a blight.

Based on the above indicator, a scoring tabulation was made to categorize the condition of the tree, that are health, little damaged, moderately damaged and heavily damaged levels. See the table 1.
| Variables          | Parameter          | Tree Health Parameters                                                                 | Score | %   |
|--------------------|--------------------|---------------------------------------------------------------------------------------|-------|-----|
| The health of stem | Heavily Damaged    | There are holes in hollow stems or stems, stem and branch cancers, marked by swelling of the trunks and branches which are sporadic, branch skin peeling and darker in colour. | 2     | 30% |
|                    | Moderately Damaged | There are pests and diseases with a hole in the stem and branches. Signs that are easily seen are wood dust and dark coloured sap coming out of the hole. | 3     |     |
|                    | Little Damaged     | There is a hole in the stem but does not remove dirt and sap.                        | 4     |     |
| Health             |                    | There is no trunk hole, no cancer and no pest attack                                | 5     |     |
| The health of header | Heavily Damaged  | Half the canopy of the tree dies or there is dead shoots (main shoots), dry or molested (not when shedding leaves or dry season). | 2     | 30% |
|                    | Moderately Damaged | There are several dead branches.                                                     | 3     |     |
|                    | Little Damaged     | There is a leaf attack, marked by the yellow spots on the leaves evenly               | 4     |     |
| Health             |                    | No part of the canopy or leaves are attacked by pests                                | 5     |     |
| Variables          | Parameter          | Tree Technic Condition Parameters                                                    | Score | %   |
| The slope of the tree | Heavily Damaged   | The slope of stem forms an angle of less than 70°, a small part of the ground is cracked around the roots. | 2     | 20% |
|                    | Moderately Damaged | Slope rate of 70-80°                                                                 | 3     |     |
|                    | Little Damaged     | Slope rate of 80 – 90°                                                                | 4     |     |
| Health             |                    | The tree is perpendicular (90 – 100°)                                                | 5     |     |
| Mechanical damage to trees | Heavily Damaged | There is destruction of $\frac{1}{2}$ part of the plant up to or not up to the roots | 2     | 20% |
|                    | Moderately Damaged | There is an incision or destruction of the tree to the inside (cortex)               | 3     |     |
|                    | Little Damaged     | There are incisions or damage only to the epidermis                                  | 4     |     |
| Health             |                    | There is no mechanical damage                                                         | 5     |     |
3. Discuss

3.1. Distribution of Tree Condition

After counting, there are 2,753 trees (2,198 trees at Slamet Riyadi street, 151 trees at Jendral Sudirman street and 404 trees at Urip Sumoharjo street). The next step are comprehensively tabulating data to produce a score of the categorized of tree condition, that is: health, little damaged, moderate damage and heavily damaged or fallen prone. The table also shown the photos to visualized the physical data of the tree. In this form also informed the condition of the stand, roots, trunks, canopy and urban infrastructure around the tree (such as roads, gutters, buildings and so on). See the table 2.

All of data categorized based on predetermined criteria (see table 1). On Slamet Riyadi street, there are 2,198 trees consisting of 57 species of trees, spread on the north side of 931 trees and on the south side of 1,267 trees. The most species of trees are Glodokan (Polyalthia longifolia) 230 trees (10.46%), then Angsana (Pterocarpus indicus) 188 trees (8.55%), Apple Bludru (Diospyros blancoi A. DC.) 146 trees (6.64%), and Asem Keranji (Dialium indum) 126 trees (5.73%).

Not much different, the condition of the green roadside at Jendral Sudirman street mostly have good condition (health and little damaged). In the Jendral Sudirman street, there are 151 trees with 20 species, spread on the west side 71 trees and on the east side 80 trees, (2) Most tree species are Glodokan pecut (Polyalthia longifolia) 41 trees (27.15%), Angsana (Pterocarpus indicus) 17 trees (11.26%).

The trees at Jendral Sudirman street are mostly in good condition (health). Trees are prone to falling as many as 6 trees (3.97%) with the category of fallen prone (heavy damage) and moderate damage. The 6 trees consist of the Bangur (Langerstroemia), Cemara (Casuarina equisetifolia), Angsana (Pterocarpus Indicus), Dadap merah (Erythrina cristagalli) Sawo Kecik (Manilkara kauki), and Glodokan pecut (Polyalthia longifolia). The fallen vulnerability is caused by (1) hollow and hole the stems, (2) pests on the stems become brittle, (3) swelling in the trunk, (4) part or all of the canopy of dead trees, and (5) non-upright stems (tilt).

At Urip Sumoharjo street there are 404 trees consisting of 26 species, spread on the west side 212 trees and on the east side 191 trees. The most tree species are 129 Tanjung (Mimusops elengi) 31.93%, then Glodokan pecut (Polyalthia longifolia) 94 trees (23.27%), Angsana (Pterocarpus indicus) 50 trees (12, 38%) and Malaba (Mangifera kemanga) 28 trees (6.93%). Of all the existing trees have quite diverse conditions. Young trees tend to be health, whereas some older trees have poor health and technical conditions. Trees with moderate and heavy prone
Table 2: Tree Condition Table at Slamet Riyadi street

| No | Name               | Ordinate      | Canopy width | Total score | Tree condition |
|----|--------------------|---------------|--------------|-------------|----------------|
| 1  | Glodokan pecut     | -2.557986, 110.79585 | 50           | 400         | Light Damage   |
|    | (Polyalthia longifolia) | SR 0000 S  | 1.8          | 8.5         |                |
|    |                    |               | 0.8          |             |                |
| 2  | Bistara (Cerbera Manghas) | -2.557868, 110.79702 | 46           | 450         | Health         |
|    |                    | SR 0001 S  | 1.2          | 7           |                |
|    |                    |               | 1.2          |             |                |
| 3  | Malau (Sosietana SP) | -2.557977, 110.79000 | 40           | 430         | Health         |
|    |                    | SR 0002 S  | 1           | 6           |                |
|    |                    |               | 2           |             |                |

a  Etc.

Table 2: Tree Condition Table at Slamet Riyadi street

| Location | Canopy width | Total score | Tree condition |
|----------|--------------|-------------|----------------|
| Glodokan pecut (Polyalthia longifolia) | 50 | 400 | Light Damage |
| Bistara (Cerbera Manghas) | 46 | 450 | Health |
| Malau (Sosietana SP) | 40 | 430 | Health |

conditions were 31 trees (7.6%). Trees with moderate and heavy damage consist of Tanjung (Mimusops elengi), Akasia (Acacia auriculiformis), Angsana (Pterocarpus Indicus), Glodokan pecut (Polyalthia longifolia), Malaba (Mangifera kemanga) and Beringin (Ficus benjamina). Some of these trees have conditions: (1) hollow and hole stems, (2) swelling in the trunk, (3) some of the tree canopies are dead, and (4) some sloping trunks.

Most of the trees had health conditions (1,259 trees = 57.28%) and little damaged (705 trees = 32.07%). All young trees (less than 10 cm in diameter) are in good health. 234 trees (10.64%) have moderate and heavy damage condition. Me most of them are Asem Keranji (Dialium indum) and Angsana (Pterocarpus Indicus). Indications of damage has showing by: (1) hollow stem; (2) there is a pest attack on the stem and brittle; (3) There is swelling in the stem and some die; and (4) technically a portion of the sloping stem. See the table 3 with symbol $H_1 =$ health condition, $H_2 =$ light demage, $H_3 =$ moderate demage, and $H_4 =$ heavy demage.

Refering the data compilation, it can be seen that the dominant trees planted on all of the roadises are the type of Glodokan pecut (Polyalthia longifolia), Angsana (Pterocarpus indicus), Apple Bludru (Diospyros blancoi A. DC.), Asem Keranji (Dialium indum), Tabebuya rosea, Tanjung (Mimusops elengi), Akasia (Acacia auriculiformis) and Malaba (Mangifera kemanga). If we compare the tree species with the tendency of damage, we see that all tree species have relatively the same tendency to damage. Glodogan pecut (Polyalthia longifolia), the tree type as Malaba (Mangifera kemanga), Apples Bludru (Diospyros blancoi A. DC.) and Tabebuya have a health category or have a strong endurance. While Angsana (Pterocarpus indicus), Erythrina, Sawo Kecik (Manilkara kauki), Bungur (langerstroemia) and Casuarina tend to be damaged or unhealth. See the table 4.

When viewed from the shape of the canopy, all of the trees do not have special characters have broad canopy) except Polyalthia longifolia with a slim canopy. This shape making it relatively safe or strong to withstand wind loads. Based on these conditions, health factors (disease and insect attack) as well as the technical condition of the tree are factors that determine the level of
Table 3: Categories of Tree Condition

| No | Local and Scientific Name of the Tree           | Amount (%) | The tree condition |
|----|------------------------------------------------|------------|--------------------|
|    |                                                |            | $H_1$  | $H_2$  | $H_3$  | $H_4$  |
| 1  | Glodokan (Polyalthia longifolia)               | 227        | 10.33  | 106    | 89     | 31     | 1      |
| 2  | Angsana (Pterocarpus indicus)                  | 187        | 8.51   | 85     | 62     | 35     | 5      |
| 3  | Apel Bludru (Diospyros blancoi A. DC.)         | 145        | 6.60   | 137    | 6      | 1      | 1      |
| 4  | Asem Keranji (Dialium indum)                   | 125        | 5.69   | 19     | 67     | 36     | 3      |
| 5  | Bintaro (Cerbera manghas)                      | 121        | 5.51   | 49     | 56     | 14     | 2      |
| 6  | Tanjung (Mimusops elengi)                      | 113        | 5.14   | 68     | 39     | 6      | 0      |
| 7  | Savo Kecik (Manilkara kauki)                   | 113        | 5.14   | 62     | 36     | 15     | 0      |
| 8  | Mahoni (Swietenia SP)                          | 110        | 5.00   | 67     | 36     | 6      | 1      |
| 9  | Bungur (langerstroemia)                        | 108        | 4.91   | 51     | 46     | 11     | 0      |
| 10 | Palm                                           | 96         | 4.37   | 72     | 22     | 1      | 1      |
| 11 | Ketapang kencana (Terminalia mantaly)          | 88         | 4.00   | 68     | 17     | 3      | 0      |
| 12 | Akasia (Acacia auriculiformis)                 | 82         | 3.73   | 30     | 30     | 20     | 2      |
| 13 | Malaba (Mangifera kemanga)                     | 81         | 3.69   | 44     | 29     | 7      | 1      |
| 14 | Kamboja (Plumeria)                             | 70         | 3.18   | 54     | 16     | 0      | 0      |
| 15 | Asem Jawa (Tamarindus indica)                  | 69         | 3.14   | 31     | 32     | 6      | 0      |
| 16 | Glodokan pecu (Polyalthia longifolia)          | 66         | 3.00   | 20     | 41     | 5      | 0      |
| 17 | Kiyauna Payung (Filicium decipiens)            | 54         | 2.46   | 29     | 22     | 3      | 0      |
| 18 | Beringin (Ficus benjamina)                     | 40         | 1.82   | 32     | 6      | 2      | 0      |
| 19 | Walisongo (schefflera actinophyla)             | 39         | 1.77   | 36     | 3      | 0      | 0      |
| 20 | Mangga (mangifera indica)                      | 38         | 1.73   | 26     | 11     | 1      | 0      |
| 21 | Ketapang (Terminalia catappa)                  | 31         | 1.41   | 22     | 8      | 1      | 0      |
| 22 | Tabebuya                                      | 18         | 0.82   | 13     | 3      | 2      | 0      |
| 23 | Perdu                                         | 18         | 0.82   | 16     | 2      | 0      | 0      |
| 24 | Spatodea (Spathodea campanulata)               | 18         | 0.82   | 17     | 1      | 0      | 0      |
| 25 | Other trees (each species less than 1%)        | 142        | 6.46   | 107    | 24     | 11     | 0      |
|    | Total                                         | 2.198      | 100.00 | 1.259  | 705    | 217    | 17     |

This makes the management and maintenance of trees as a determines factor in quality of trees, determines when trees can be cut down or just simply care / maintenance.

In addition to paying attention to the technical aspects of trees (fallen-prone), the choice of tree species needs to pay attention to several other factors. Road sides are areas that function for the safety and comfort for road users, land for road development, buffer zones, greenery road sides, construction sites for service facilities and protecting natural formations. The selected planting vegetation at road sides is very important (Klemm, Heusinkveld, Lenzholzer, & Hove, 2015). The selection of vegetation must be adjusted with the characteristics of the vegetation. The existence of well-managed trees in urban areas can be beneficial to stabilize the conditions of the urban environment from pollution. The trees benefit in the urban environment: improving air quality noise reduction, increasing air humidity and decreasing surrounding temperatures, beautifying cities, preservation of ground water and improving traffic safety and supporting economic sustainability (Agnihotri, Ohri, & Mishra, 2018; Hao, Zhu, & Zhong, 2015; Ghofrani, Sposito, & Faggian, 2017). The benefits of greenery road sides can be optimized if the tree has health growing, not damage.

Based on the study, many of trees planted are not in a health condition. Almost 40% of trees have damaged conditions ranging from minor, moderate and severe damage categories). These tree vulnerability. This makes the management and maintenance of trees as a determines factor in quality of trees, determines when trees can be cut down or just simply care / maintenance.
Table 4: Comparison of the dominance of tree species planted and tree species that tend to be damaged

| Information                              | Slamat Riyadi street | Jendral Sudirman street | JI Urip Sumoharjo |
|------------------------------------------|----------------------|--------------------------|-------------------|
| The dominant tree species are planted on each road section | Glodokan pecut (*Polyalthia longifolia*) | Glodokan pecut (*Polyalthia longifolia*) | Tanjung (*Mimusops elengi*) |
|                                           | Angsana (*Pterocarpus indicus*) | Angsana (*Pterocarpus indicus*) | Glodokan pecut (*Polyalthia longifolia*) |
|                                           | Apel Bludru (*Diospyros blancoi A. DC.*) | Tabebuya rosea | Angsana (*Pterocarpus indicus*) |
|                                           | Asem Keranji (*Dialium indicum*) |                           | Akasia (*Acacia auriculiformis*) |

| Condition | amount | %     | amount | %     | amount | %     |
|-----------|--------|-------|--------|-------|--------|-------|
| Health    | 1,259  | 57.28%| 95     | 62.91%| 265    | 65.59%|
| Light Damage | 705    | 32.07%| 50     | 33.11%| 110    | 27.23%|
| Damage    | 217    | 9.87% | 6      | 3.97% | 27     | 6.68% |
| Very damage | 17    | 0.77% | 0      | 0.00% | 2      | 0.50% |
| amount    | 2,198  | 100.00%| 151    | 100.00%| 404    | 100.00%|

| Dominant tree damaged | Asem Keranji (*Dialium indicum*) | Angsana (*Pterocarpus indicus*) | Bungor (*longerstroemia*) |
|                       |                                  | Casuarina                      |                               |
|                       |                                  | Angsana (*Pterocarpus indicus*) |                               |
|                       |                                  | Dadap Merah (*Ervirina cristogali*) |                               |
|                       |                                  | Seno Kecik (*Mamillara kanki*) |                               |
|                       |                                  | Glodokan pecut (*Polyalthia longifolia*) |                               |
|                       |                                  |                                   | Tanjung (*Mimusops elengi*) |
|                       |                                  |                                   | Angsana (*Pterocarpus indicus*) |
|                       |                                  |                                   | Glodokan pecut (*Polyalthia longifolia*) |
|                       |                                  |                                   | Beringin (*Ficus benjamina*) |

Trees need adequate care so that the damage is getting worse. The health of trees determined by factors (1) plant selection, (2) planting methods, and (3) management of post-planting and maintenance. Plants will grow well if the selected plants are tolerant of the planting environment. The correct planting method will prepare a place that guarantees well root and canopy growth. Proper maintenance will guarantee growth at a normal pace, avoiding pest and vandalism. Conversely, if the factors that determine the growth are not right, then the plants will grow slowly, do not display the desired physical properties, and even plants will at any time fall.

3.2. Tree Handling and Maintenance

Some alternative for tree treatments that are: (1) High or width trimming. High trimming or cutting the tree needs to make balancing the height of the tree by supporting the roots. Normally, the root can be expanded beyond the width of the crown. This handling is not only for safety aspects (such as falling down when there are strong winds and heavy rain), cutting can also be used to obtain uniformity in tree height. Width cutting the tree canopy is based on two considerations, namely safety and health. As same as the height trimming, width trimming is feared that the canopy that is too wide on the tree cannot withstand from the wind and heavy rain. The falling down of the branches are endanger road users; (2) Control from passenger plants (parasite). A parasite or a semi-parasitic plant takes food essence from its host. To eradicate parasites, by cleaning the roots of parasitic plants; (3) Patching on Hollowed Trees. Trees that have been damaged by holes in the stem can be overcome by using a method of cavity treatment. In this method, the hole of stem covering or filling with composite mortar, sand and splits or concrete; (4) Control of Plant Pests. Pests are plant disruptors in the form of organisms. Pests attack the plant tissue cause the tree damage, disease and death. Most pests are insects such as termites, caterpillars, fleas, insect borer, and others; the last is (5) tree
logging as the last choice. Tree logging based on safety considerations only (the tree have heavy
damage or death, so that is dangerous or vulnerable to falling).

Through adequate handling, green urban space is also expected to be beneficial in supporting
public health as reported by the World Health Organization (WHO). Some activities carried
out in Green urban space can increase relaxation and recovery, increase social capital, improve
immune system function, improve fitness and reduce obesity, reduce anthropogenic noise and
produce natural sounds, reduce exposure to air pollution, reduce the effects of urban heat
islands, increase pro-environment behaviour, optimization of sun exposure thereby improving
sleep quality.

4. Conclusion
The Surakarta City Environmental Office has made a Tree Inventory Application, named
SIPPOHON. This application to manage a large number of tree data, 2,753 trees (2,198 trees
at Slamet Riyadi street, 151 trees at Jendral Sudirman street and 404 trees at Urip Sumoharjo
street). The number of these trees will continue to grow over a wide area survey. Through
SIPPOHON trees can be inventoried by the name, type and characteristics. Tree location is
integrated in a global positioning system (GPS) switch is followed up with the provision of tree
card identification. With the existence of SIPPOHON, maintenance, care and felling of trees on
the green roadside can be managed well and right on target. The dominant trees planted on all
of the road sides are the type of Glodokan pecut (Polyalthia longifolia), Angsan (Pterocarpus
indicus), Apple Bludru (Diospyros blancoi A. DC.), Asem Keranji (Dialium indum), Tabeuya,
Tanjung (Mimusops elenqi), Akasia (Acacia auriculiformis) and Malaba (Mangifera kemanga).
If we compare the tree species with the tendency of damage, we see that all tree species have
relatively the same tendency to damage. Glodogan pecut (Polyalthia longifolia), the tree type
as Malaba (Mangifera kemanga), Apples Bludru (Diospyros blancoi A. DC.) and Tabeuya have
a health category or have a strong endurance. While Angsan (Pterocarpus indicus), Erythrina,
Sawo Keck (Manilkara kauki), Bungur (langerstroemia) and Casuarina tend to be damaged
or unhealth. Some forms of tree damage are caused by: hollow and hollow trunks; mechanical
damage (scratches and cuts that hurt the tree to the cortex); pest attacks that cause the stems to
become brittle; swelling of the stem; the partial canopy is dead; trees tilted into the electricity
grid; and roots come to the surface. To improve tree management in the green roadside in
the Surakarta city, it is recommended: (1) Treatment of pests that are attacked by pests with
moderate to heavy damaged conditions in accordance with existing characteristics to prevent the
spread of disease and damage that is getting worse; (2) Routine tree maintenance needs to be
carried out such as pruning, pest control, fertilizing, watering and strengthening of sloping trees;
and (3) Competent tree monitors and nurses are needed as well as involving the community to
regularly monitor the condition of trees.

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