Early identification of the quality of tree pruning cuts in a Bogor campus area

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Abstract. Shading trees on the side of the road of the city or in the university campus areas can provide many benefits. Nowadays, people consider these trees as an important living component for improving the quality of built environment. However, these trees also can endanger the safety of the people around them if they are not well maintained. One of the important causes is due to improper pruning which could cause more damages to the trees and longer cut recovery. Information on the quality of pruning cuts is usually not available for planning good tree maintenance. This research was conducted with an objective to identify the quality of tree pruning cuts in a campus area belonging to Bogor Agricultural University (IPB) located in Dramaga, Bogor. There were five species of trees investigated in this study, namely Samanea saman, Filicium decipiens, Chrysophyllum cainito, Mimusops elengi and Cinnamomum burmanni with a total of 50 trees spreading in several crowded places. Each tree was identified by observing the pruning cuts condition done by the workers. A total of 93.91% pruning cuts were carried out improperly, while only 6.09% out of the pruning cuts were conducted properly. The results indicated that the quality of tree pruning cuts performed by the workers was very low, that may be associated with the low knowledge and skill of the workers on pruning techniques.

1. Introduction
Urban forests have several benefits for example to provide on urban landscape aesthetics [1] and absorb pollution [2]. People have considered trees in urban areas as an important aspect that could improve the quality of life [3]. However, many recreational areas such as streets have great risks of accidents caused by the trees [4]. Good pruning is the best treatment that can be given to trees in the city [5]. Pruning is one of several routine maintenance for keeping trees healthy and attractive [6]. Maintaining the trees, mainly by pruning, is usually applied to trees that are in the crowded and popular areas, such as trees in the city parks. Trees pruned improperly could lead to devastating impacts not only to the trees, but also to the public who walk around the trees. Improper tree pruning could damage the trees and require a longer period to recover, therefore the risks of damage to the trees increases [7]. Improper pruning techniques will certainly make the bad pruning cuts. Improper pruning cuts often lead to larger wound the trees which require a longer period to recover. Information relating to improper pruning cuts has not been widely reported in Indonesia, especially in the Bogor area. In this case, therefore, identifying the quality of tree pruning cuts is indeed necessary. Therefore, the objective of this study was to identify the quality of tree pruning cuts on selected trees growing in Bogor Agricultural University (IPB) Darmaga Campus, Bogor, West Java, Indonesia.
2. Methods
This study was conducted in four locations in IPB Darmaga campus, Bogor, West Java, Indonesia, i.e Graha Widya Wisuda (GWW) parking lot, Student Center (SC) parking lot, Common Class Room (CCR) frontage, Andi Hakim Nasution park lot. These locations were selected because various student activities are held nearby. In this study, five different tree species i.e Samanea saman, Minusops elengi, Filicium decipiens, Cinnamomum burmanni, and Chrysophyllum cainito with a total of 10 trees for each species or a total of 50 trees were examined. The equipments used in this study were stationery, netbook, wide zoom lens, handphone and softwares such as the Microsoft Office Word 2013, Microsoft Office Excel 2013 and SPSS 16. The data of the quality of tree pruning cuts was recorded using a mobile camera equipped with a wide zoom lens and stationery. It was identified from each pruning cut at the tree as a result of pruning previously done by tree pruning workers at each research location. The data were analyzed and described with a percentage of tree pruning cut in graphic formats and a box plot of the distribution of pruning cuts.

3. Results and discussion
Pruning practice as one of the activities for maintaining trees could harm the trees. However, it could cause more harms which may take longer for a cut to recover if the pruning has been done improperly. Figure 1 indicates that the number of improper pruning cuts that had a higher percentage of 93.91% compared to the number of proper pruning cuts that is only 6.09%. The data demonstrated the percentage of the five identified tree species scattered in each study site. These results showed an evidence that the majority of cuts on 50 individual trees were done improperly. The findings indeed suggest for better awareness to the workers regarding good practices in tree maintenance. Pruning is the best treatment that can be given to a tree, but if pruning is done improperly, it will cause the worse harm to the tree [5]. Pruning is a practice that is recognized, but many practices have been done improperly because of the lack of knowledge of proper pruning techniques that not only may harm the tree but endanger the people around them.

![Figure 1. Percentage of pruning cut.](image)

Figures 2a, 2b, 2c, 2d, and 2e clearly pointed how diverse the value between a proper and an improper pruning cuts. The present study distinguished the value range between the proper and improper pruning cuts in five tree species observed. Figure 2 also explains that the average distribution of proper pruning cuts on four out of five tree species is 0 (nill) cut where one species had an average of 1 cut (C. cainito). The result portrayed that the number of proper pruning cuts between each species has no significant difference. The result also displayed that the number of proper pruning cuts from 50 identified trees could range between 0 (all species) to 4 (C. burmanni) cuts. These circumstances were
distinguished significantly with improper pruning cuts, which the number on one tree could range between 2 (M. elengi & C. cainito) to 19 (F. decipiens) cuts. Whereas the average distribution of improper pruning cuts in each species of tree tended to be more diverse, ranging between 4 (C. cainito) to 10 (F. decipiens & M. elengi) cuts. The number of improper pruning cuts on each tree species also did not have significant differences between one tree species and another (figure 2). This condition proved that the tree species had no significant meaning from the pruning technique performed by the tree pruning workers. Successful pruning could be done if proper pruning technique is properly understood[8]. Proper pruning techniques would certainly develop good quality pruning cuts, while acknowledging the objective of pruning is also important. One of several reasons for pruning is to maintain safety and shape and size of the trees [6]. The main reason for pruning ornamental trees and shade trees is for safety, health and aesthetics [9]. Furthermore, pruning for health-related reasons is projected by eliminating the infected, crossed and rubbed branches, besides the depleted and pest-infested parts, while pruning for safety can be held by removing branches that can fall and block traffic signs, then on the other hand pruning for aesthetic reasons was conducted by adding flowers and shaping the trees. [9]

![Box plots showing proper and improper pruning cuts for the tree species of: (a) S. saman, (b) M. elengi, (c) F. decipiens, (d) C. burmanni, (e) C. cainito.](image-url)
Figure 3. The tree pruning cuts from five tree species (a) A pruning with a stub cut, (b) Torn branches up to the main stem, (c) Pruning cuts at the outermost point of the branch collar and branch bark ridge.

Five trees were improperly pruned with stub cuts. Stub cuts are the pruning cuts made too far from the farthest branch bark ridge or branch collar that may leave too much branch tissue [9] as shown in figure 3a. Meanwhile, there were no flush cut at the pruning cuts on the five tree species. Flush cut was once considered a decent pruning practice because it was done as close as possible to the main trunk, but at present, it is not recognized as a proper pruning technique [5]. Flush cut is a technique of tree pruning in the interior part or the rear part of the branch bark ridge or branch collar, causing unnecessary wound to the stem tissue [9].

A branch collar is a swollen area at the core of the branch, while the branch bark ridge raises from the bark of a tree as a mark between the main stem and branch [10]. The proper pruning cuts must be done as close as possible to the branch collar without cutting the branch collar itself [5], as shown in figure 3c. On the other hand, stub cuts as a result of improper pruning must be removed as shown in figure 3a. Leaving too many stubs when cutting would kill the outer layer of the branch collar and certainly threaten the tree’s health in general [11].

Figure 4. Callus formation (a) healthy, (b) callus, which is not closed may be infested and infected.

Figure 3b and 5b illustrate the pruning that may tear off the bark of the branch which may harm the main stem. Furthermore, a cut done improperly can damage the tree because the cut is an opening that occurs in trees when the bark of a live branch or stem is cut, removed or decayed [11]. Trees respond to damage or wounds in two ways, such as through the forming of a callus and isolation of the injured part and the callus formation process begins at the edge of the wound and then moves slowly toward the center of the wound, which can ultimately cover the affected part of the tree [12], as shown as in
figure 4a. However, in figure 4b, it appears that the callus could not heal the wound properly so it can cause infestation, disease and decay. This happens because workers prune the tree without acquiring the knowledge of proper pruning methods and do not follow the procedures. The advanced knowledge of appropriate pruning would certainly increase awareness to realize the ethics among the pruning workers [13].

Figure 5. The process of pruning a tree (Three Cut Method) is performed in a (a) properly, (b) improperly [5, 14].

Figure 5 demonstrates the proper pruning method or at present is known as the Three Cut Method. The Three Cut Method is a proper pruning method and is recognized today, where three pruning steps should be conducted, such as making the first cut at the bottom of the branch by not cutting the branch as a whole part, where the purpose of the first cut is to anticipate whether the branches bark peel while doing a second cut, so the main trunk is harmed, but would stop in the first cut [5]. Next stage is to make a second cut, just a few centimeters in front of the first cut by cutting the full branch [5]. Final step is the, the last cut at the outermost point of the collar branch [5].

A stub cut can be pruned again with the proper method in order to form the callus properly. It is necessary for the dead branches on the tree to be pruned immediately in order to reduce harm. Furthermore, pruning done by professional workers is the best option that can be done for managing trees at urban areas [8]

4. Conclusion
The results on the quality of tree pruning cuts in IPB Darmaga Campus through observing five tree species, showed clear differences between the proper and improper pruning cuts. The proportion of improper pruning cuts were much higher than those of the proper pruning cuts. All the improper pruning cuts left too many stubs (Stub Cuts) and there were also callus formation which was considered unhealthy and increased awareness on the tree condition. The practice of improper pruning cut indicated that the workers were still lacking of pruning knowledge and skills. It is recommended that the tree pruning workers should be trained properly.

References
[1] Gorman J 2004 Residents’ opinions of the value of street trees depending on tree location Arboric. J. 30(1) 36–44
[2] Stoffberg G H, Van Rooyen M W, Van Der Linde M J and Groeneveld H T 2010 Carbon sequestration estimates of indigenous street trees in the City of Tshwane, South Africa Urban For. Urban Green. 9(1) 9–14
[3] Lohr V I, Pearsons-Mims C H, Tarnai J and Dillman D A 2004 How urban residents rate
and rank the benefits and problems associated with trees in cities *Arboric. J.* 30(1) 28–35

[4] Ellison M 2007 Moving the focus from tree defects to rational risk management—A paradigm shift for tree managers *Arboric. J.* 30(2) 137–142

[5] Shigo A L 1984 Tree decay and pruning *Arboric. J.* 8(1) 1–12

[6] Maede G and Hansley D 1998 *Pruning Landscape Trees and Shrubs* (Honolulu: University of Hawaii at Manoa) pp 1

[7] Clark J and Matheny N 2010 What does research tell us about the practice of pruning in arboriculture? *Arborist News* 19(1) 41–47

[8] Sellmer J C, Cotrone V J, McGann M and Nuss J R 2004 *Pruning ornamental plants* (Pennsylvania : The Pennsylvania State University) pp 3–16

[9] Bedker P J, O’Brien J G and Mielke M M 1995 *How to prunes trees* (Washington DC : USDA Forest Service) pp 1–12

[10] ANSI A300 2008 Tree, Shrub, and Other Woody Plant Management – Standard Practices (Pruning) (Washington DC : American Nasional Standards Institute) pp 2

[11] Neely D 1970 Healing of wounds on trees *J. Am. Soc. Hortic. Sc.* 95 536–540

[12] Shigo A L 1977 A new look at tree care *Arboric. J.* 3(3) 157–164

[13] Badrulhisham N and Othman N 2016 Knowledge in Tree Pruning for Sustainable Practices in Urban Setting: Improving Our Quality of Life *Procedia Soc. Behav. Sci.* 234 210–217

[14] The National Forest 2006 *Pruning for Quality a National Forest Guide* (Derbyshire: The National Forest) pp 14