TITLE: TREE CLASSIFICATION BASED ON TREE RING QUALITY IN CENTRAL JAVA

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Abstract. In Central Java Indonesia, many tropical trees don't produce distinct rings. This has caused difficulties in defining tree rings for dendrochronology. The quality of tree rings is very important to know the past environmental conditions including climate, weather, rainfall, disease, and fire. The purpose of this study was to classify wood based on the quality of tree rings. The method used in this study was a survey in Banyumas, Cilacap, Purbalingga, Banjarnegara and Wonosobo, Central Java. The material used were samples of wood pieces from felling in the area. Furthermore, the assessment of the ring quality was carried out by polling and sending questionnaires to respondents to assess each tree species. Each ring consisting of early wood and late wood was observed under a microscope. The results of this study indicate that there are three groups of trees, namely trees with: 1) Very distinct annual rings including *Pinus merkusii*, *Melia azedarach*, *Toona sureni*, and *Hevea brasiliensis*, 2) Medium annual rings including *Swietenia mahagoni*, *Hibiscus tiliaceus*, and *Persea americana*, 3) unclear or absent tree rings including *Gnetum gnemon*, *Parkia speciosa*, and *Baccaurea racemosa*. An important finding that can be concluded is that the majority of distinct annual rings come from medium to high lands.

Keywords: classification, quality, tree ring, wood

A. Introduction

Indonesia is one of mega diversity countries in the world. As the quantity of tree species is very high [1], tree grouping becomes very important. Unlike temperate trees, which typically form clear growth rings due to seasonal changes, many tropical trees don't produce distinct rings [2]. The tree ring provides valuable tool for understanding past climate. Each ring on a tree represents a year of growth, and its characteristics, such as width and density, can reveal a lot about the environmental conditions during that year.

In tropical climates like those in central Java, where conditions are more stable year-round, growth can be continuous. Some tropical species may show faint rings or none at all, making it difficult to determine their age using traditional dendrochronology methods. Factors like species type, environmental conditions, and growth patterns all play a role in this variability. Formation of distinct tree rings is uncertain due to the lack of strong seasonal variation in climate factors [3].

One of the factors deterring the use of trees as proxy data sources is that longer-lived species frequently contain anomalous rings, particularly faint rings [4]. The quality of tree rings is very important to know the environmental conditions including climate and weather. The ring quality is influenced by rainfall, disease, and fire [5]. When the tree rings are not clear, or even none, tree species selection becomes very important.

Exploration is a crucial step in identifying trees with desirable tree rings. This process involves a systematic survey and documentation of trees within a specific area namely Central Java. Exploration is so important because different tree species produce varying ring patterns [7]. Inventarization helps pinpoint species known for their distinct and well-defined rings, such as pines, cedars.

B. Methods

The method used in this study was a survey in Banyumas, Cilacap, Purbalingga, Banjarnegara and Wonosobo, Central Java, with snowball sampling technique. The assessment of the ring quality was carried out by voting [6] and sending questionnaires to respondents. The rings were scored as 5 (very distinct), 4 (distinct), 3 (medium), 2 (unclear), 1 (no tree ring). Then the tree rings were observed under the microscope. The early wood and late wood colors were measured with muncellcolor2 and described with color hexa.

C. Results And Discussion

1. Description

The description of research results should be clearly and precisely written. Results should be sufficiently explained and can be supported by tables, graphics or figures. Discussion must concise and appropriately interpret the results. It should explain the meaning and usefulness of the finding as an answer to the research problem.

2. Figures and Tables

Figure 1. A distinct tree rings in cross section of A) Melia azedarach, B) Hevea brasiliensis, C) Altingia excelsa, D) Pinus merkusii, E) Tectona grandis, F) Dalbergia latifolia, G) Toona sureni, H) Hibiscus tiliaceus, I) Peronema canescens, and J) Archidendron pauciflorum

Table 1. Ten best quality tree rings based on polling by16 respondents

No	Scientific Names	Name	Score	Early & Late wood
1	*Melia azedarach*	Chinaberry tree	87	Light brown & light brown
2	*Hevea brasiliensis*	Rubber	81	Whitish & yellowish
3	*Altingia excelsa*	Rasamala	77	Blackish & brownish
4	*Pinus merkusii*	Pine	73	Brown & yellowish
5	*Tectona grandis*	Teak	73	Reddish brown & reddish brown
6	*Dalbergia latifolia*	Sonokeling	71	Yellowish & yellowish
7	*Toona sureni*	Surian	65	Light brownish & light brownish
8	*Hibiscus tiliaceus*	Waru	61	Yellowish & yellowish
9	*Peronema canescens*	Jati sabrang	58	Yellowish & yellowish
10	*Archidendron jiringa*	Jengkol	57	Light brownish & light brownish

Based on the structure of the rings, there are three groups of trees namely 1) annual rings with uniform color between early wood and late wood, each ring is separated by xylem canal holes, 2) annual rings with uniform color between early wood and late wood, each ring is not separated by xylem holes, 3) early wood and late wood with different colors, each ring is not separated by xylem chanal holes.

The first group consists of four trees with almost similar structure of tree rings, namely chinaberry tree, rubber plant, surian, and sungkai. *Melia azedarach*, or chinaberry tree (Meliaceae) is a fast-growing species [8] of tree with very distinct annual growth rings. All respondence said that this tree has the best tree rings. Although there is almost no difference color in both early wood and late wood, however, there are very distinct boundary between annual rings, in the form of xylem channel holes. Rubber plant *Hevea brasiliensis* (Euphorbiaceae) is also another tree species with very distinct annual rings. Similar to chinaberry tree, this species has also distinct boundaries between rings. *Toona sureni*, or surian, a medium-sized to fairly large tree up to 40 m tall, and 100 cm in diameter, has also a very distinct tree rings. *Peronema canescens* or sungkai also has similarly distinct tree rings due to the presence of xylem hole.

The second group consists trees with medium annual growth ring such as the teak (*Tectona grandis*), *Dalbergia latifolia*, *Hibiscus tiliaceus*, *Archidendron jiringa.* When they are old, these trees usually produce heartwood, so the color of the wood on the edges is very different from the inside. Currently, there are many fast growing wood such as those with the heartwood of fast plantation grown teak destined for harvest at 5 years of age [9].

Thirdly, trees with distinct annual rings due to different colors between early wood and late wood. This group consists of *Pinus merkusii*, and *Altingia excelsa.* In the pine, the early wood is normally much lighter than those in the late wood. This tree has high potential to reconstruct past weather conditions from their tree rings [10]. Altingia excelsa was classified as a valuable and durable hardwood timber species [11] with distinct tree rings.

D. Conclusion

Based on tree ring quality, there are three main groups of trees i.e. trees with: 1) Very distinct annual rings including *Pinus merkusii*, *Melia azedarach*, *Toona sureni*, and *Hevea brasiliensis*, 2) Medium annual rings including *Swietenia mahagoni*, *Hibiscus tiliaceus*, and *Persea americana*, 3) unclear or absent tree rings including *Gnetum gnemon*, *Parkia speciosa*, and *Baccaurea racemosa*. An important discovery is that the majority of distinct annual rings come from medium to high lands.

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F. References

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