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STRUCTURE AND COMPOSITION OF TREES IN THE GIRIMANIK NATURAL FOREST AREA, WONOGIRI, CENTRAL JAVA

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ABSTRACT

A tree is a woody plant with a main trunk and branches that grow upwards. Trees play an ecological role as carbon reserves and habitats for various fauna. This research is important to provide references related to tree diversity and natural forest ecosystems as a basis for policy-making to support ecosystem sustainability. Research on tree vegetation has never been conducted in the Girimanik Wonogiri Natural Forest Area, therefore, this study aims to observe the structure and composition of trees in this area. Data was collected using the one-hectare plot method, with 25 plots each measuring 20 x 20 cm. To meet the plot criteria for vegetation analysis, plot placement was carried out using the purposive sampling method. The results of this study show that the Girimanik Natural Forest Area has 40 species from 24 families, with the tree species having the highest importance value index are Quercus sundaica (Pasang pranak) (25.30 %) and Ficus padana (Jurang) (24.75 %). The plant with the largest diameter is Trema orientalis. Natural forests have the highest tree diversity compared to artificial forests or agroforestry systems. This study has significant implications for biodiversity management, ecosystem conservation, and strategic forest restoration planning. The ecological data generated can serve as a basis for assessing forest health, elucidating plant community dynamics, and formulating evidence-based conservation and management strategies.

Keywords: *Girimanik; Natural Forest; Quercus lineata; Tree; Vegetation analysis*

INTRODUCTION

Forests are renewable natural resources that are crucial to the functioning of forest ecosystems (Maulana et al., 2019). Forests are vast ecosystems that contain biological natural resources, including trees, poles, saplings, and seedlings (Melaponty et al., 2019). Indonesia's forest comprises three distinct natural ecosystems: monsoon forests, mountain forests, and lowland forests. Mountain forests exhibit cooler and more humid temperatures relative to lowland forest. Mountain forests are categorized into two types: high mountain forests and low mountain forests (Wiryono, 2020). Community forests are entirely managed by the local community, but customary regulations are maintained for both their holy ritual significance and their ecological functions related to water and agriculture (Nur et al., 2022).

The Girimanik Natural Forest Area is located in Setren Village, Slogohimo District, Wonogiri Regency, adjacent to Karanganyar Regency and Ponorogo Regency. The Girimanik Nature Forest Area is administered by Forest Management Units (KPH) Surakarta, Forest Management Subunit (BKPH) South Lawu, and Village Forest Community Institution. This Natural Forest region features three waterfalls that draw tourists: Manikmoyo Waterfall, Tejomoyo Waterfall, and Condromoyo Waterfall, and its further functions as a Nature

Conservation Area. Natural forest area functions as a vital support system for biodiversity and the ecological equilibrium, enhanced by the presence of flora (Solehah et al., 2023). Forest areas provide purposes including conservation, safeguarding life support systems, and functioning as protected forests (Arba et al., 2023).

Biodiversity refers to the myriad types of life on Earth, encompassing plants, animals, microbes, and their respective habitats. Biodiversity is categorized into three levels: genetic diversity, species diversity, and ecological diversity. Moreover, biodiversity comprises two distinct components: species richness and evenness richness (Wulandari et al., 2023). Species diversity can augment the stability of the current ecosystem. Biodiversity emerges from variations in structure and composition within a region, which indicate the diversity of vegetation types present in that forested area. In vegetation, there exists a close contact between the constituent individuals and other species, facilitating the effective functioning of life systems (Herman et al., 2022).

Trees are vital organisms in the forest, serving as primary components that contribute significantly to water management, erosion prevention, habitat provision for other forest fauna, and the national economy (Martono et al., 2019). The most significant gauge of biodiversity is the presence of trees; higher number of tree species indicates greater biodiversity (Safei et al., 2021). The growth rates, allocation patterns, and biomass of various tree species in forest ecosystems differ, which can affect carbon sequestration (Fobane et al., 2024). Additionally, the planting of trees under the ground in arboreal communities can help to conserve soil and water. Plants situated beneath the ground have an advanced root system that can create a dense network, which will safeguard against soil erosion and boost organic matter quantity (Hermawan et al., 2024).

The diversity of tree species in vegetation indicates variations in composition, encompassing variances in shape, structure, morphology, color, number, and other plant features within a given area (Latumahina et al., 2021). Trees possess a distinctive attribute, specifically a diameter of less than 20 cm, with planting distance being a critical determinant of diameter growth. The density of plants influences the competition for growing space to get water, sunshine, and nutrients.

Vegetation refers to the assemblage of all plants inhabiting a particular region or area, or a specific group of plants situated in a designated locale (Roziaty & Pristiwi, 2020). The distribution of vegetation is intricately linked to environmental circumstances. Organisms in a specific location are interdependent, and the disturbance of one organism will influence the environmental parameters of the entire community (Roziaty & Wijaya, 2019). Vegetation analysis is essential for examining the advancement and evolution of succession. Vegetation analysis is a methodical quantitative examination of the composition and structure of plant communities within a designated area (Santhyami, & Aryani, 2024).

Presently, studies on arboreal vegetation are not extensively available in the Girimanik Natural Forest Area. According to the observational results from the field, the Girimanik Natural Forest Area possesses significant conservation potential; thus, it is essential to identify the tree species within this region. Conducting tree-level vegetation observations will facilitate the categorization of tree kinds and the identification of previously unknown tree species. The author aims to investigate the diversity of tree vegetation types to identify tree species and assess the extent of natural vegetation in the Girimanik Natural Forest Area, Setren Village, Slogohimo District, Wonogiri Regency, Central Java.

METHODS

Sample location and sampling

This research was conducted over four months, from October 2024 to January 2025. The research site is located in the Girimanik Natural Forest Area, Setren Village, Slogohimo District, Wonogiri Regency, Central Java **(Figure 1)**. It is bordered to the north by Karanganyar Regency, to the south by Pacitan Regency, to the west by Sukoharjo Regency, and to the east by Ponorogo and Magetan Regencies. It is positioned astronomically between 110º41'-111º18' E and 7º32'-8º15' S. This Natural Forest spans around 32 hectares, facilitating plant growth and development, characterized by a temperature range of 22-26°C, soil moisture levels of 20-40%, light intensity of 900-1500 cd, and a soil pH of 7.5-8. Monthly precipitation varies from 450 mm to 129 mm, with an average of 9 to 21 days of rainfall (BPS Wonogiri 2023). The majority of its natural habitat comprises limestone mountains (BPS Wonogiri, 2018).

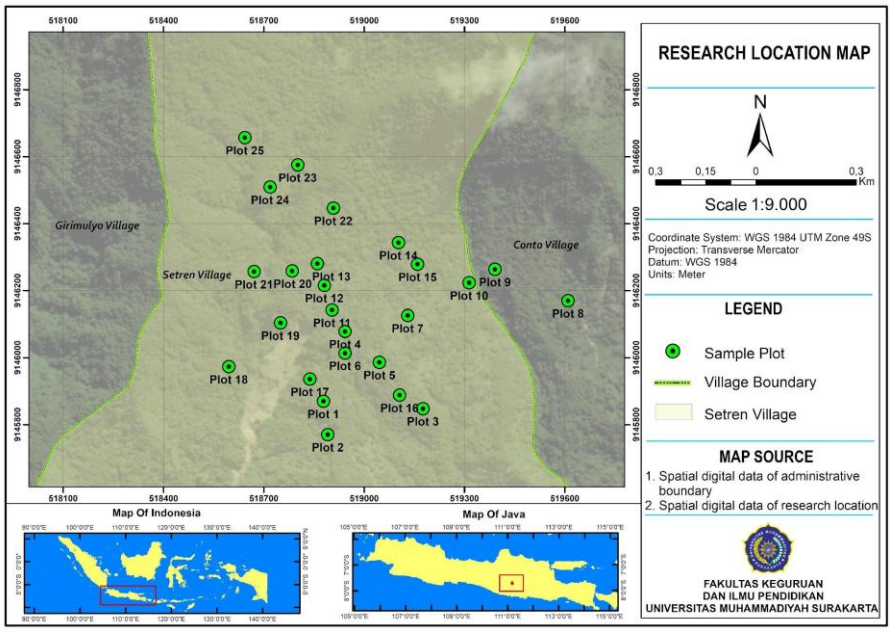

Figure 1. Research Location Map

Data collection

Data collection was performed via a methodology involving 25 plots **(Figure 1)**, each measuring 20 x 20 cm, aggregating to a total area of 1 hectare. The diameter at breast height (DBH) of all trees was recorded. Each plot coordinate is documented via GPS Essential. Area curves for species are created based on the number of species present and the size of the area. From these curves, the area occupied by each species is determined using the minimum plot area or the smallest area utilized (Nursyahra & Meriko, 2016). The 1-hectare plot was selected based on standard ecological criteria: it represents typical vegetation of the study area, avoids edge effects or disturbed zones, and maintains relatively uniform topography to reduce environmental variability. The one-hectare size follows established protocols in forest ecology, enabling data comparability across studies (Condit, 1995). Accessibility and safety were also considered to support consistent fieldwork. In each plot, observations and recordings of species names, individual counts, and diameter at breast height (DBH) are performed, together with assessments of environmental parameters such as air temperature, air humidity, soil pH, and light intensity (Packalen et al., 2023).

Identification in the Laboratory

We further gathered plant herbarium specimens for subsequent identification. All individual trees within each plot were designated by area and gathered in a container. The trees in the plot are measured for diameter at breast height (DBH), after which samples are collected for the herbarium by positioning them between sheets of newspaper, compressing them with cardboard or yellow board, and securing them tightly with twine. All species within the plot are measured to ascertain the circumference of the trees. Unidentified species were subsequently collected for inclusion in a herbarium and identification at the Biology Education Laboratory, Faculty of Teacher Training and Education Sciences, Universitas Muhammadiyah Surakarta. The identification and nomenclature of each tree species adhere to the flora book, prior research, and the identification key book.

Data Analysis

Vegetation measurements will be documented on a tally sheet by categorizing trees with a diameter of ≥ 20 cm. Subsequently, it is organized to ascertain the relative density, relative frequency, relative dominance, and importance value index employing the calculation formula (Santhyami et al., 2021). The diversity index and dominance index quantitatively characterize species distribution by measuring the number and abundance of species in a specific area, hence identifying regions of high biodiversity and corresponding conservation needs (Kitikidou et al., 2024). Measurements of environmental parameters across individual plots, including temperature, humidity, soil pH, and light availability, in relation to species distribution and dominance, reveal a significant correlation. Variations in these abiotic factors are shown to play a critical role in shaping community structure and determining species distribution patterns within the studied habitat (Nurmalasari et al., 2024)

RESULT AND DISCUSSION

Within 25 plots, each measuring one hectare, there exist 744 trees, encompassing 40 species and 24 families. Among the 40 species (refer to Table 1), 12 tree species exhibit a significant importance value (IV) of ≥ 10, specifically *Abelmoschus moschatus, Artocarpus camansi, Colona serratifolia, Ficus padana, Ludwigia octovalvis, Macropanax dispermus, Pinus merkussi, Pygeum parviflorum, Quercus lineata, Quercus lucida, Quercus sundaica,* and *Schima walichii.*

Table 1. Relative density, relative frequency, relative dominance, and importance value index.

No	Scientific Name	Local Name	Family	RD (%)	RF (%)	RDo (%)	IV (%)
1	*Abelmoschus moschatus* Medik.	Kapasan	*Malvaceae*	4.03	3.66	3.20	10.89
2	*Aglaia heptandra* Koord. & Valeton	Pancal Kidang	*Meliaceae*	0.54	1.05	0.41	2.00
3	*Antidesma ghaesembilla* Gaertn.	Ande-andean	*Phyllanthaceae*	0.67	1.57	0.44	2.69
4	*Artocarpus camansi* Blanco.	Cruwut	*Moraceae*	6.05	4.71	2.35	13.11
5	*Baeckeae frutescens* L.	Cucur	*Myrtaceae*	0.13	0.52	0.05	0.71
6	*Bischofia javanica* Blume	Gintungan	*Phyllantaceae*	0.13	0.52	0.06	0.72
7	*Breynia sp.* L.	Imer	*Phyllantaceae*	0.40	1.57	0.21	2.18
8	*Cachosus alstuans* L.	Kopen	*Meliaceae*	2.96	2.09	1.43	6.48
9	*Caesalpinia bonducella* L.	Keng-keng	*Caesalpiniaceae*	2.28	2.09	2.20	6.58
10	*Colona serratifolia* Cav.	Towok	*Malvaceae*	6.05	7.33	3.55	16.93
11	*Dendrocnide stimulans* (L.f.) Chew	Kemaduh	*Urticaceae*	0.13	0.52	0.06	0.72

12	*Delonix regia* (Bijer ex Hook). Raf.	Gulmo	*Melastomaceae*	0.81	2.09	5.07	7.97
13	*Dodonaea viscosa* Jacq.	Wesen	*Sapindaceae*	0.13	0.52	0.06	0.72
14	*Elaeocarpus ganitrus* Roxb. ex G. Don	Jenggitren	*Elaeocarpaceae*	0.13	0.52	0.98	1.64
15	*Erythrina variegata*	Dadap	*Fabace*	0.40	1.05	0.19	1.64
16	*Ficus fistulosa* Reinw. Ex Blume	Wilodo	*Moraceae*	1.08	2.09	0.52	3.69
17	*Ficus grossulariodes* Burm.f.	Kebak	*Moraceae*	0.40	0.52	0.25	1.18
18	*Ficus padana* Burm.f.	Jurang	*Moraceae*	12.90	5.76	6.07	24.73
19	*Ficus uncinata* (King) Becc.	*Dali*	*Moraceae*	1.34	2.09	1.92	5.36
20	*Ficus variegata* L.	Gondang	*Moraceae*	1.08	1.05	0.68	2.80
21	*Glochidion rubrum* Blume	Dempul	*Phyllanthaceae*	1.08	2.62	0.67	4.36
22	*Lithocarpus sundaicus* (Blume). Rehder	Pasang Kodok	Fagaceae	7.53	6.28	4.07	17.88
23	*Ludwigia octovalvis* (Jacq.) P.H. Raven	Lombokan	*Onagraceae*	4.17	6.28	3.01	13.46
24	*Macaranga tanarius* (L.) M A	Tutup	*Euphorbiaceae*	0.94	1.57	0.73	3.24
25	*Macropanax dispermus* (Blume) Kuntze	Pampung	*Araliaceae*	9.14	1.57	11.25	21.96
26	*Pinanga coronata* Blume.	Palem piji	*Araceae*	0.81	0.52	0.35	1.68
27	*Pinanga speciosa* Becc.	Palem nduru	*Araceae*	0.40	6.28	0.25	6.94
28	*Pinus merkusii* Jungh. & de Vriese	Pinus	*Pinaceae*	6.72	3.66	11.50	21.89
29	*Planchonia valida* (Blume) Blume	Puthek	*Lecythidaceae*	1.48	2.62	4.23	8.33
30	*Pygeum parviflorum* Craib.	Nyampoh	*Rosaceae*	4.44	2.09	4.77	11.30
31	*Quercus lineata* Blume.	Pasang Tiris	*Fagaceae*	0.54	0.52	0.22	1.28
32	*Quercus lucida* (Roxb.) Rehd.	Pasang kapur	*Fagaceae*	3.49	5.24	4.79	13.52
33	*Quercus sundaica* Rehder.	Pasang pranak	*Fagaceae*	7.26	6.81	11.23	25.30
34	*Saurauia bracteosa* DC.	Lotrok	*Actinidiaceae*	1.34	2.09	0.62	4.06
35	*Schima walichii* (DC.) Korth	Puspa	*Theaceae*	6.59	4.19	5.55	16.32
36	*Syzygium polyanthum* (Wight) Walp.	Salaman	*Myrtaceae*	0.54	0.52	0.63	1.70
37	*Toona sureni* (Blume) Merr	Suren/Jitren	*Meliaceae*	0.54	2.09	0.24	2.87
38	*Treculia africana* Decne. ex Trecul	Talesan	*Moraceae*	0.40	1.05	0.19	1.64
39	*Trema orientalis* (L.) Blume	Anggrung	*Cannabaceae*	0.81	2.09	5.42	8.32
40	*Vitex Pinnata L.*	Labangan	*Lamiaceae*	0.13	0.52	0.73	1.39
	Total			100	100	100	300

Note: Relative Density (RD), Relative Frequency (RF), Relative Dominance (RDo), and Importance Value Index (IVI)

Out of a total of 40 species, there are 6 species with a density of only one tree/ha **(Figure 2)**. The diversity index is classified as high, which is 5, and the dominance index obtained is 0.06, or classified as moderate. According to Pertiwi et al., (2019) the diversity index value ranges from 0-7, with the criteria: 0-1 (low), 1-3 (medium), and > 3 (high). With this, the diversity index in the Girimanik Natural Forest Area is classified as high, while the dominance index is classified as moderate. This is supported by the research of (Mbong et al., 2020) which states that the diversity and dominance indices will have low values due to the effects of human settlements, logging, agriculture, and development activities. In this case, Girimanik Natural Forest Area has a high diversity index and a moderate dominance index because the forest is located far from residential areas, agriculture, free from deforestation, and development. In addition, the village forest community institution that collaborates with Forest public company serves as a control in the management of forest resources and the utilization of the forest by the community (Anggiani & Hikmawan, 2022).

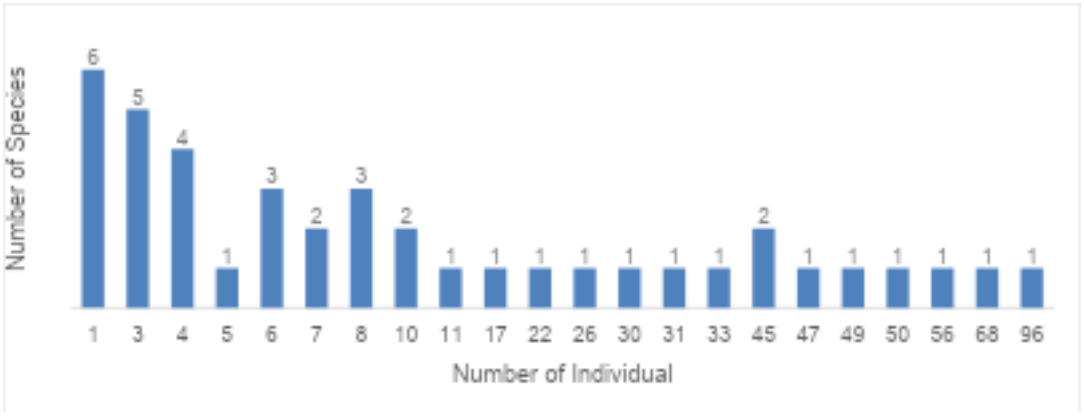

Figure 2. The number of species and the number of individual trees in a one-hectare forest area in the Girimanik Natural Forest Area, Setren, Wonogiri, Central Java

(Table 1) illustrates the variation in density, frequency, and dominance of species within the plot. The highest density calculations among several species are observed in *Ficus padana*, succeeded by *Macropanax dispermus*. The density of various species reflects the predominance of a single species in a given locale and influences its abundance relative to others. The greatest frequency is observed in *Colona serratifolia*, succeeded by *Quercus sundaica*. The greatest dominance is observed in *Pinus merkussi*, succeeded by Macropanax dispermus, while the highest important value index is recorded for *Quercus sundaica* (25.30 %) and *Ficus padana* (24.73 %). Table 3 presents the five families exhibiting the highest relative density, relative frequency, relative dominance, and greatest important value, specifically the Moraceae and Fagaceae families.

The data indicates a considerable community density, with certain species exhibiting the highest density, particularly *Ficus padana*. A high density value of a plant species signifies its capacity to adapt to its environment, reproduce, and compete with other plants (Nuraida et al., 2022). The forest exhibits a random distribution of growth types due to the presence of several seed-eating animals and environmental conditions that facilitate the proliferation of species. The density of the arboreal community can help forecast the health status of the forest (Kayombo et al., 2022). According to Kawung et al., (2020), the species exhibiting the highest density among others is presumed to possess superior adaptability to its environment, with its elevated dominance attributed to a trunk circumference greater than that of competing species. Muharani & Mahmud, (2022) and Riaño et al., (2024), assert that environmental elements, including height, air humidity, air temperature, and sunshine intensity, significantly impact vegetation, hence influencing the distribution and growth of plant species. The arbitrary distribution of trees in the forest is affected by various causes, including seed-consuming animals like bats and birds.

Quercus sundaica and *Ficus padana* had the greatest significance value index among tree species. *Quercus sundaica* is a member of the genus Quercus, characterized by gray bark, a smooth texture, spherical and hairy seeds adorned with fine golden hairs in their juvenile stage, and cup-shaped brown seeds at maturation. The abaxial surface of the leaves possesses a waxy feel. The *Quercus sundaica* tree inhabits lower to higher mountain forests at altitudes of 1000-2000 meters above sea level, thriving in sandy or limestone soils (Li et al., 2016). The leaves of that plant possess a high nitrogen content, resulting in their rapid decomposition compared to those of trees with less nitrogen (Rahajoe et al., 2021). *Ficus padana* is a shrub measuring 6 to 15 meters in height and 30 centimeters in diameter. This tree features white latex leaves that are oval-shaped, heart-shaped at the base, flat-edged, serrated, and covered in scratchy white hairs. *Ficus padana* is a fig flower situated in the leaf axil, spherical in form, measuring 4-5 mm in diameter, and transitions to crimson or black upon ripening. *Ficus padana* possesses ecological capabilities that facilitate water management

and features roots adept at soil stabilization; furthermore, it effectively absorbs CO2 and other airborne contaminants. This tree's habitat is located in tropical rainforests adjacent to riverbanks and cliffs (Hendrayana et al., 2021).

Table 2. Ten Species with Highest Relative Density (RD), Relative Frequency (RF), Relative Dominance (RD), and Highest Important Value Index (IVI)

Species group	Spesies
a. Ten species with the highest relative density	*Ficus padana (12.90 %), Macropanax dispermus (9.14 %), Lithocarpus sundaicus (7.53 %), Quercus sundaica (7.26 %), Pinus merkusii (6.72 %), Schima walichii (6.59 %), Artocarpus camansi (6.05 %), Colona serratifolia (6.05 %), Pygeum parviflorum (4.44 %), Ludwigia octovalvis (4.17 %)*
b. Ten species with the highest relative frequency	*Colona serratifolia (7.33 %), Quercus sundaica (6.81 %), Ludwigia octovalvis (6.28 %) Lithocarpus sundaicus (6.28 %), Pinanga speciosa (6.28 %), Ficus padana. (5.76 %), Quercus lucida (5.24 %), Artocarpus camansi (4.71 %), Schima walichii (4.19 %), Abelmoschus moschatus (3.66 %)*
c. Ten species with the highest relative dominance	*Pinus merkusii (11.50 %), Macropanax dispermus (11.25 %), Quercus lineata (11.23 %), Ficus padana. (6.07 %), Schima walichii (5.55 %), Trema orientalis (5.42 %), Delonix regia (5.07 %), Quercus lucida (4.79 %) Pygeum parviflorum (4.77 %), Planchonia valida (4.23 %)*
d. Ten species with the highest Important Value Index (IVI)	*Quercus sundaica (25.30 %), Ficus padana. (24.73 %), Macropanax dispermus (21.96 %), Pinus merkusii (21.89 %), Lithocarpus sundaicus (17.88 %), Colona serratifolia (16.93 %), Schima walichii (16.32 %), Quercus lucida (13.52 %), Ludwigia octovalvis (13.46 %), Pygeum parviflorum (11.30 %)*

Table 3. Five families of Highest Relative Density (RD), Relative Frequency (RF), Relative Dominance (RD), and Highest Important Value Index (IVI)

Characteristics	**Families**
Five families with the highest relative density	Moraceae (22.85 %), Fagaceae (18.28 %), Malvaceae (10.08 %), Araliaceae (9.14 %), Theaceae (6.59 %)
Five families with the highest relative frequency	Fagaceae (18.32 %), Moraceae (16.75 %), Malvaceae (10.99 %), Phyllantaceae (6.81 %), Araceae (6.81 %)
Five families with the highest relative dominance	Fagaceae (20.06 %), Moraceae (11.71 %), Pinaceae (11.49 %), Araliaceae (11.23 %), Malvaceae (6.74 %)
Five families with the highest Important Value Index (IVI)	Fagaceae (56.66 %), Moraceae (51.31 %), Malvaceae (27.81 %), Araliaceae (21.94 %), Pinaceae (21.87 %)

The Fagaceae family typically thrives at altitudes ranging from 600 to 1,500 meters above sea level. The genus Quercus is recognized for its growth in lowland regions. The Fagaceae family possesses specific growth factors and distribution patterns (Zainun et al., 2024). The primary determinants are soil, temperature, and altitude. The Fagaceae family predominantly inhabits hill forests, low mountain forests, and mountain forests. The Fagaceae family exhibits limited adaptability to severe forest types, including peat woods, limestone slopes, and heath forests. The Fagaceae family in Indonesia comprises 112 species, including the genus Quercus, which contains 19 species distributed over Kalimantan, Sumatra, and Java. Fagaceae wood types often consist of single-stemmed trees featuring buttress or stilt roots. The wood can be exceptionally hard and challenging to manipulate, rendering it less appropriate for construction materials; yet, its exquisite grain is highly excellent for furniture. The population of Fagaceae

timber in the wild is declining due to its utilization as a construction material in Indonesia. If exploitation persists, a significant fall in the population is anticipated. Restoring it to a primary forest will require some time. The Fagaceae family typically features pendulous flower clusters known as "catkins" and seeds encased in a hard structure referred to as a "cupule" or little cup. Besides wood, Fagaceae yields other non-timber products, including tannins and chestnuts (seeds); nevertheless, these items are frequently disregarded due to their inferior monetary value compared to wood (Purwaningsih & Polosakan, 2016).

The Girimanik Natural Forest Area contains numerous tree species with the biggest diameters in the forest. **(Figure 3)** The four largest species, each exceeding a diameter of 350 cm, are *Delonix regia* (356 cm), *Quercus sundaica* (360 cm), *Planchonia valida* (450 cm), and *Trema orientalis* (500 cm). The mean diameter of the predominant species in the dataset is approximately 60-69, comprising a total of 236 specimens. No individuals with a diameter between 400 and 499 were identified. (Roziaty & Wijaya, 2019), assert that a community often comprises diverse plant species. A community's age or stability correlates positively with the diversity of plant kinds present. Similar to Girimanik Natural Forest Area, which features diverse plant species and several mature trees with substantial widths, indicative of their age, contributing to a stable forest ecosystem. (Salwanafi et al., 2023), assert that a successful succession process will alter the diversity value, albeit insignificantly. No invasive tree species detrimental to the tree community were identified in the forested region, which also contains multiple places with a canopy of mature trees. Regions characterized by a canopy of substantial trees that permit sunlight to penetrate to the forest floor, so supplying the requisite light intensity for optimal plant growth and development, are optimal for plant population expansion. Moreover, there are no invasive species that would adversely affect biodiversity (Suhendar et al., 2020). Abiotic factors significantly affect tree growth density, as evidenced by the study of (Roziaty & Utomo, 2018), which indicates that temperatures between 24.6°C and 23.3°C, along with humidity levels of 61%-66%, facilitate tree growth due to the indirect influence of abiotic factors on the survival of organisms in a specific region.

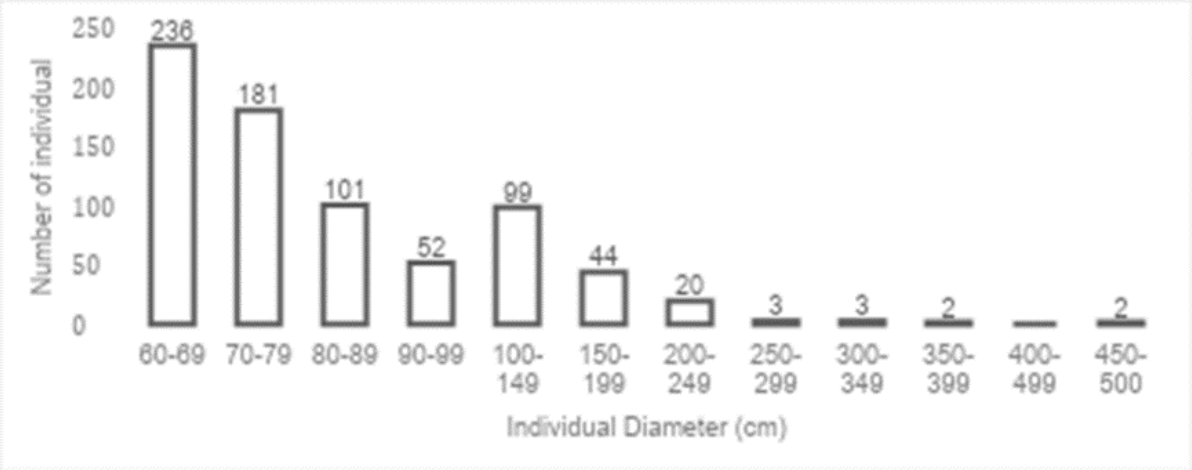

Figure 3. Number of trees by diameter (cm)

Table 4. Comparison of tree diversity in several natural forests on the island of Java

No	Locality	Methods	Area of plot (ha)	Number of trees	Number of species	Number of families	Source
1	Natural Forest Area Girimanik, Wonogiri, Central Java	Quadrat	1	744	41	24	Present study

2	Urban Forest Cikampek City, West Java	Quadrat	1	202	25	10	(Yulianti et al., 2022)
3	Tourist Area *Curug* Gondoriyo, Ngaliyan District, Semarang City, Central Java	Quadrat	1	346	39	17	(Jannah et al., 2024)
4	Agroforestry System Gundih, Grobogan, Central Java	Quadrat	1	341	12	9	(Santhyami & Isnaini, 2023)

The tree is a rare species, distinguished by its biggest diameter among its counterparts, and is situated in a forest that is infrequently reached by the population. Several years prior, a conflagration ravaged Girimanik Natural Forest Area; yet, *Trema orientalis* emerged as one of the species that exhibited accelerated growth post-fire. (Peng et al., 2022), indicate a substantial positive link between growth and tree size; nevertheless, trees of identical size may exhibit considerable variation in growth rate, leading to larger trees having enhanced access to light and nutrients.

Several studies delineate the ecosystems of various forests on the island of Java. The organized data collection will be juxtaposed with a compilation of plot data analogous to the forests in the Java Island region **(Table 4)**. This study will compare the richness of tree species with other natural forest studies in the Java Island region.
The species richness and tree density in the Girimanik Conservation Area surpass those of various forests on the island of Java; however, it exhibits similarities in tree dominance with the Curug Gondoriyo area, which is predominantly characterized by Ficus species. These plants typically thrive in riparian zones, facilitating seed dispersal through water and certain frugivorous animals, such as birds, which aid in the proliferation of Ficus growth (Jannah et al., 2024). Both the Girimanik Natural Forest Area and the Curug Gondoriyo Area share similar ecological conditions, where the highest plant diversity and elevated humidity levels are consistently found in areas surrounding the waterfalls.

(**Table 4)** indicates that the quantity of trees in natural forests surpasses that in artificial forests. Girimanik Natural Forest Area and the Curug Gondoriyo region possess a greater diversity of species than the Cikampek City Forest and the Gundih Agroforestry System, in addition to a substantial tree population. The biodiversity in artificial forests is typically inferior to that of natural forests. This results from the restricted variety of species cultivated and the absence of structural complexity in artificial forests (Solehah et al., 2023). Additionally, natural forests possess more intricate habitats that sustain greater biodiversity than artificial forests (Kusmana & Melyanti, 2017).

Various tree species in the Girimanik natural forest area region, including *Schima walichii*, are deemed beneficial; local inhabitants assert its efficacy as a treatment for muscle pain, and according to (Almadani & Hermawan, 2023), it exhibits commendable fire resistance. The *Schima wallichii* species is frequently cultivated to mitigate the risk of forest fires resulting from extended drought conditions. This species' trunk can be employed as a construction material due to the high quality of its wood and its moisture resistance; its leaves may also serve as fodder for cattle. Research in the Gundih region indicates that some trees can be employed to generate natural colors from their trunks and leaves, utilized in batik fabric manufacture (Santhyami & Isnaini, 2023).

CONCLUSION

This research concludes that Girimanik Natural Forest Area contains 744 tree types, represented by 40 species in 24 groups. This study classifies the tree species diversity index as high and the dominance index as moderate, with *Quercus sundaica* and *Ficus padana* exhibiting the greatest Important values index. *Trema orientalis* possesses the biggest trunk diameter among other flora and is the tallest species in the forest. Natural Forest Areas exhibit superior tree diversity in comparison to artificial forests or agroforestry systems. This study has significant implications for biodiversity management, ecosystem conservation, and strategic forest restoration planning. The ecological data generated can serve as a basis for assessing forest health, elucidating plant community dynamics, and formulating evidence-based conservation and management strategies.

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