Katilayu (*Lepisanthes rubiginosa* (Roxb.) Leenh.) Population In Mt. Baung Nature Tourism Park

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**Abstract.** Katilayu (*Lepisanthes rubiginosa*) is one of the native plants of Indonesia that has not been much studied for the information on its existence and its potential utilization. This species has the risk of decreasing its population in nature due to several things, including the assumption of some people that this plant produces "fossil latex" which has magical abilities that increase the potential for exploitation; the other potential benefits and uses are not well known, so their cultivation is neglected; and the decreasing extent of forests in Indonesia. Research at Mt. Baung Nature Tourism Park (NTP), Pasuruan, East Java was carried out to determine the population of katilayu in the conservation area, to be precise by analyzing the vegetation and data collection on the number of individuals in the conservation area of Mt. Baung NTP. Observation of the physical environment where it grew was also done to find out the picture of the condition of the environment in which it grows. From this study it was known that the condition of the population in Mt. Baung was still quite good with the composition of individual densities at each growth stratum still showing a normal graph, that was inverted J-shaped form. Its presence was relatively scattered throughout the study site.

**Keywords:** katilayu, *Lepisanthes rubiginosa*, Mt. Baung

1. **Introduction**

*Lepisanthes rubiginosa* (Roxb.) Leenh. is one plant species that belongs to family Sapindaceae. This plant becomes the concern of some people because it is believed to produce "fossil latex" which has a magical ability to attract the attention of others, or is used as a charm talisman. The hardened and formed fossil latex is the most searched and utilized. This sap is known as the “katilayu” fossil. It is believed by the community that to get it one must go through and perform the ritual process first. Specifically there are even some people who believe that it is a talisman to produce a lot of catch when fishing. Concern over excessive exploitation of it arises because more and more people are looking for and using it.

Heyne [1] noted that katilayu wood was used as material for making kitchen utensils and equipments, and the young leaves were used as vegetables. Pounded of young leaves mixed with water was used as a liniment to reduce fatigue. Chewed leaves was used as a medicine for peeled skin, while the ripe fruit can be eaten as snacks. It was stated on Susiarti's notes [2] that people on Weh Island in Aceh traditionally utilized its leaves for a mixture of vomiting drugs. Uddin et al [3] recorded that this species was found in Lawachara National Park, Bangladesh. It was known by the local name “Chagalnadi” and the leaves were used as a medicine for fever.
Several studies were conducted to determine the potential of the active ingredient contained in the *Lepisanthes rubiginosa*. Barua et al [4], Rana et al [5] suggested that there were potential substances as anti-bacterial and anti-fungal substances.

The research of Lestari et al [6] suggested that the saplings of *Erioglossum rubiginosum* (a synonym for *Lepisanthes rubiginosa*) were quite common in the Ciapek Block area, Cikered Wildlife Sanctuary, where the area had the character of lowland coastal forest type. Wibowo et al [7], suggested that the species *Erioglossum rubiginosum*, which in the local language was known as kilalayu, was quite commonly found growing in green open areas of burial areas in the City of Banjarbaru. Research conducted by Sulaiman et al [8] suggested that ecologically the presence of *Lepisanthes rubiginosa* planted in urban forests in Malaysia acted as a habitat for birds to feed and nest. Awang et al [9] suggested that this plant was one of the native species known in Malaysia and had the potential to be developed as an exotic landscape plant. In another study, Boonsuk and Chantaranonthai [10] suggested that in Thailand there were known as many as seven species of *Lepisanthes*, one of which was *L. rubiginosa*.

Ghazalli et al [11] suggested that the micromorphological character of *Lepisanthes* leaves consisting of variations in cuticle perceptual character, stomata structure, waxy type and trichome morphology can be used to help identify *Lepisanthes* species. Putri et al [12] characterized the wood anatomy of this family. Nine wood samples from the genus *Filicium, Mischocarpus, Lepisanthes, Pometia, Xeroperum, Guiua, Sapindus, Harpullia* and *Nepheleium* were used in the anatomical characterization of wood. Burger [13] described the character of the seedlings or saplings of *Erioglossum rubiginosum* to help identifying plant species in the forest.

Purwodadi Botanical Garden as one of the ex situ plant conservation institutions has seven species of *Lepisanthes* collections, namely: *Lamoea* Hassk. Leenh., L. *blumeana* Koord. & Valeton, L. *frutescens* Blume, L. *fruticosa* (Roxb.) Leenh., L. *ramiflora* (Radlk.) Leenh., L. *rubiginosa* (Roxb.) Leenh., L. *senegalensis* (Poir.) Leenh., and *Lepisanthes* spp. The total number of plant specimens was 16 plants [14].

Information about this species population in nature in addition to some of the places that have been studied above, is still very necessary. Mt.Baung NTP is one of the conservation areas adjacent to the Purwodadi Botanical Garden which is managed by the East Java Natural Resources Conservation Center (BBKSDA). Mt. Baung was designated as a Nature Tourism Park based on Decree of the Minister of Agriculture No. 657 / Kpts / Um / 12/1981, dated January 1, 1981, covering an area of 195.50 Ha. Administratively, Mt Baung NTP area is located in Cowek Village, Purwosari District, Pasuruan Regency, East Java. Geographically, the location is at 07° 46' 09" N, 07° 47" 23" South Latitude and 112° 16" 23" and 112° 17" 17" East Longitude [15] [16].

From Mudiana research [17] it was known that one of the plant species found growing in the forest area of Mt. Baung NTP is *Lepisanthes rubiginosa*. Based on these results further studies and research were conducted which include extracting information about the population and its presence in the Mt. Baung forest area. This study aimed to determine the population and habitat conditions of *Lepisanthes rubiginosa* at Mt. Baung.

### 2. Methods

This research data collection activity was carried out from November 2011 to February 2012, in the NTP area of Mt. Baung, East Java [17]. The study was conducted by analyzing vegetation by determining the blocks of observation plots conducted purposively which were expected to be able to represent all the ecosystem conditions on Mt. Baung. Based on the results of the preliminary survey carried out, there were determined as many as five locations for the observation block placement (Figure 1). For each block, vegetation data collection was carried out by making observation plots using the checkered line method. At each location of the observation block, 5 transects were made in which observation plots were made. Vegetation data collected were: plant species name and the number of individuals in each measurement strata from seedlings and undergrowth, saplings, poles
and trees. Data on plot locations with *Lepisanthes rubiginosa* were tagged and documented using Etrex type Garmin GPS.

![Figure 1. Location of Mt. Baung NTP and observation areas [17]](image)

A 2 x 2 meter$^2$ plot was used for plants with seedling and undergrowth strata, 5 x 5 meter$^2$ plot for sappling level, 10 x 10 meter$^2$ plot for pole level, and 20 x 20 meter$^2$ plot for tree level. The number of lanes made were 5 lanes with a length of 200 lanes each. The sample plot area was 200 x 20 x 5 meter$^2$ (2 hectares) for one observation block location. Thus the total area of observation plots made was 5 x 2 ha = 10 ha (Figure 2).

![Figure 2. Observation plots in the transect line in each block of the observation location [17]](image)

Data from vegetation analysis results were further analyzed to determine the condition of *Lepisanthes rubiginosa* at the study site, especially related to Density and Relative Density, Frequency and Relative Frequency as well as Domination and Relative Dominance to find out the Importance Value Index. Distribution maps were obtained by transferring data from GPS using source map software and Google Earth.

Recording environmental data was carried out in each observation plot. Environmental data recorded included: light intensity, air temperature, humidity, soil acidity / pH, soil moisture, slope, and altitude. This data was then used to determine the similarity of conditions in each observation block. Cluster analysis was carried out using Minitab16. Garmin GPS type eTrex Vista HGiX was used to document and mark geographical positions in the field; Yenaco type SH-121 digital thermohigrometer was used to measure air temperature and humidity conditions; Krisbow type KW light meter 06-28B
for measuring light intensity; Suunto clinometer for measuring slope; and Portable Soil pH Meter Moisture Sensor Tester (T20B type) was used to measure acidity and soil moisture.

3. Results and Discussion

3.1. The vegetation condition of Mount Baung and the population of Lepisanthes rubiginosa

The vegetation conditions in Mt. Baung NTP were naturally dominated by bamboo species. Six bamboo species were recorded at this location, namely: Bambusa blumeana, Schizostachyum zollingeri, Schizostachyum iraten, Dendrocalamus asper, Bambusa vulgaris, and Giganthochloa apus. Bambusa blumeana, known locally as “pring ori” (because it has thorns) was the most commonly found and dominating bamboo species (Important Value Index 225.127%) and subsequently followed by Schizostachyum zollingeri (INP 46.086%) [17]. Almost in every location bamboo groves can be easily found. According to information obtained in the field, the condition and character of vegetation like this is quite vulnerable to the occurrence of fires, especially during the dry season. This is caused by a pile of bamboo litter that is quite a lot and is not easily weathered and in dry conditions will be flammable.

The presence of quite prominent tree vegetation was characterized by plant species that commonly grow in areas with a dry monsoon climate. Some of them were as follows: Ficus hispida, Schoutenia ovata, Syzygium pycnanthum, Streblus asper, Microcos tomentosa, Garuga floribunda, Ficus racemosa, Emblica officinalis, Litsea glutinosa, Albizia lebbekoides, Artocarpus elasticus, Dysoxylum gaudichaudianum, Pittosporum moluccanum, Alstonia scholaris, and Wrightia tomentosa. The vegetation pole stratum found still depict the regeneration of several species at the tree level. The following pole level species were sorted from the largest Importance Value Index (IVI): Streblus asper, Syzygium pycnanthum, Voacanga grandifolia, Microcos tomentosa, Schoutenia ovata, Syzygium racemosum, Ficus hispida, Litsea glutinosa, Pittosporum moluccanum, Protium javanicum, Tabernaemontana sphaerocarpa, Wrightia tomentosa, Syzygium litorale, Canthium glabrurn, and Emblica officinalis. While in the sappling stratum some plant species that had largest Important Value Index include: Tithonia diversifolia, Streblus asper, Voacanga grandifolia, Lepisanthes rubiginosum, Syzygium pycnanthum, Capparis micrantha, Microcos tomentosa, Schoutenia ovata, Alectryon serratus, Syzygium racemosum, Ficus hispida, Canthium glabrurn, Protium javanicum, Litsea glutinosa, and Tabernaemontana sphaerocarpa. Seedlings and undergrowth level were dominated by plant species with very fast and dominating growth such as: Tithonia diversifolia, Mikania cordata, and Cyathula prostrata. The existence of Lepisanthes rubiginosa in the composition and structure of vegetation on Mt. Baung can be illustrated from the IVI for each growth stratum. Although its existence was not found in the strata of trees. The IVI for Lepisanthes rubiginosa in each stratum were as follows: seedling rate 5.872% (10th order out of 163 recorded species), sapling level 16.109% (4th place out of 103 recorded species), and pole level 0.703 % (68th place out of 68 species recorded) From these values it can be seen that the presence of Lepisanthes rubiginosa in the vegetation on Mt. Baung was still quite visible in the vegetation composition, especially in the sappling strata.

According to Botanri [18], plant species with an IVI ≥ 10% in an ecosystem were considered as the main constituent species components of that ecosystem (Figure 3). When viewed from the individual density graph of L. rubiginosa at the study site (Figure 4b), the conditions still indicated normal population conditions for a plant species. The number of young stratum was more than the adult stratum. Because the adult stratum of Lepisanthes rubiginosa was only a shrub and / or small tree, very few were found in the pole or tree strata. The individual density graph for each growth stratum illustrates the shape of the inverted J-shaped curve form.
Figure 3. Vegetation analysis results: Importance Value Index of (a) seedlings and groundcover; (b) saplings; (c) poles; (d) trees.

Figure 4. (a) The number of individual *L. rubiginosa* in each growth stratum; (b) Graph of individual density of *L. rubiginosa*

The research of Irwanto et al [19] suggests that the population of *Castanopsis buruana* in West Seram Island shows a population structure with an inverted "J" graph. As an alternative food and other uses this plant has a relatively good population with guarantees for regeneration, where the
regeneration phase is sequentially more than the adult phase. According to Irawan [20] and Gunawan et al [21] conditions like this are generally normal conditions in the structure of tree vegetation in natural forest areas, either unspoiled or in conditions that are beginning to be disturbed. The difference is mainly in the richness of the plant species that compose it.

It was noted that *Lepisanthes rubiginosa* at Mt. Baung was more common in the seedling and sapling phases, the details were as follows: sapling level of 80 individuals, sapling level of 81 individuals, pole level of 1 individual, and tree level of 1 individual (Figure 4a). For individual density values are shown in Figure 4b. Habitus of this plant species is shrub to small tree, so that in this study it was more recorded in the strata of saplings and saplings.

A similar condition was also stated by Shankar and Tripathi [22], who suggested that in the Meghalaya lowland forest area in India the presence of *Lepisanthes rubiginosa* was found as small tree. Nasrulloh [23] stated the results of his research in the Mount Abang Nature Reserve that one of the plant species found in the area was *Lepisanthes rubiginosa*. It was known by the local name “klonoytan” and its presence was mainly found in the level youth of sappling strata. The condition and location of the Mount Abang Nature Reserve was relatively the same as the Mt Baung NTP forest area. Both were located in Pasuruan, East Java, with an area that was not quite large. Different conditions stated by Sukistyanawati et al [24], who suggested that the results of the analysis of vegetation carried out in Sempu Island Nature Reserve, it was known that quite a lot of *Lepisanthes rubiginosa* grew in this region. Its presence was found mainly in tree strata and poles which were marked with a high Importance Value Index.

The topography of the Mt. Baung NTP area is mostly undulating with steep slopes, only very few is flat. The highest peak is the peak of Mt. Baung at 501 m asl., and the lowest position is at 250 m asl. Climatic conditions in the Mt. Baung NTP (based on Schmidt and Ferguson classification) is type D, with a value of Q = 76.47%. Annual average rainfall was recorded at 2,571.5 mm with an average number of rainy days per year for 144.20 days. Daily air temperature ranges between 20 °C-23 °C. Rainy season with rainfall ≥100 mm / month, generally occurs between November to April, every year, while the dry season (with rainfall ≤ 60 mm / month) occurs between May to October [16].

### 3.2. Description of the species *Lepisanthes rubiginosa* (Roxb.) Leenh.

Adema et al [25] suggested that there were 24 species of *Lepisanthes* spread across tropical Africa, Madagascar, South Asia and Southeast Asia, from Sri Lanka to Hainan, the Malesian Region and the Southwestern Region of Australia. Especially for *Lepisanthes rubiginosa* mainly grew in the continental region of Southeast Asia from the northern part of India to the Indo-China region and southeastern China (Kwangtung, Hainan). This species was also scattered in the Malesia region and Southwest Australia (York Sound, Brunswick Bay).

*L. rubiginosa*’s habitus stature in the form of shrubs or small trees, with a height of up to 16 m. The diameter of the stem can reach up to 28 cm, but from a few notes it can be more than that. Notched branching, very short, has fine hairs on branching and young twigs. Compound leaves, with leaf size (2-) 3-6 (-9) cm, resemble velvet when the leaves are young. The length of the flowering is about 25-35 (-50) cm, with a solid ferrugineous tomentose surface. Sweet-scented flowers, orbicular-ovate petal leaf shape, slightly concave, green when fresh, sometimes petaloid margins, ciliate, glabrous inside or with some hair, outer two 1.2-2.2 by 1, 2-2 mm, acute, in three 1.8-2.8 by 2-3 mm, obtuse. Petals consist of 4 (or 5) strands, yellowish white when fresh (Figure 5). The fruit consists of 1-, 2-, or 3-lobed, diffuse lobes, measuring 8-13 by 7-8 mm in color, slightly pale in color, dark purple to almost black when ripe, in the form of subglabrous. The seeds are oblong-ellipsoid shaped, with a size of 9-11 x 4 mm.
The habitat and ecology of *Lepisanthes rubiginosa* is generally a monsoon climate and experiences periodic dry periods. Adema et al. [25] suggested that this species was rarely found growing in marshy, fertile and sterile soils, or on heavy clay soils, on sand, and on limestone. It was generally found in areas with more open tree or shrub vegetation, shed forests (common in teak forests in Central and East Java), in young secondary forests, shrubs, etc. It can also be found growing along the edge of the forest, the roadside, the edge of the river, along the inside of the mangrove forest at altitudes up to 300 (-1200) m above sea level. Backer and van den Brink [26] put forward this species in Java under the name *Erioglosum rubiginosum* (Roxb.) Bl. It spread in the habitat in the form of shrubs, on the edge of the forest, in open places and deciduous forests in western, central and eastern Java. It grew in areas at 0.5 - 1,200 meters above sea level.

**Figure 5.** Inflorescences (a, b) and habitus (c) of *L. rubiginosa*

![Inflorescences and habitus](image)

**Figure 6.** Distribution of *L. rubiginosa* at Mt. Baung NTP

![Distribution map](image)
If seen from its presence at the study site, it is known that this species can be found relatively at each location of the observation block as shown in the *Lepisanthes rubiginosa* distribution map in this study (Figure 6). The recording of environmental parameters made at each location of the meeting plot with this species is shown in Table 1. Observed parameters included: light intensity, air temperature, air humidity, soil pH, soil moisture, slope and altitude.

**Table 1.** The average value of the environmental parameters of the *Lepisanthes rubiginosa* habitat.

| Location | light intensity (lux) | temperature (°C) | humidity (%) | soil pH | soil humidity (%) | slope (%) | Altitude (m asl.) |
|----------|-----------------------|------------------|--------------|---------|-------------------|----------|------------------|
| Block 1  | 5,625.44              | 29.76            | 78.96        | 6.03    | 95.00             | 27.00    | 395.94           |
| Block 2  | 3,605.62              | 29.75            | 79.15        | 6.08    | 93.85             | 36.88    | 426.77           |
| Block 3  | 3,104.52              | 29.07            | 82.95        | 5.47    | 100.00            | 19.95    | 338.05           |
| Block 4  | 1,562.09              | 29.67            | 89.56        | 5.35    | 100.00            | 35.68    | 260.88           |
| Block 5  | 2,035.36              | 27.91            | 89.58        | 5.44    | 98.42             | 30.84    | 327.47           |
| Average  | 3,186.61±             | 29.23±0.79       | 84.04±       | 5.67±   | 97.45±            | 30.07    | 349.82±          |
|          | 1,588.60              |                  | 5.29±        | 0.35±   | 2.87±             | ±6.90    | 64.41            |

From the environmental parameters observed in each location of the observation block, the value of the parameters of light intensity and altitude have quite large differences, while the other parameter values are relatively uniform. This can be seen from the standard deviation values for each observed parameter value. The two environmental parameters, i.e. light intensity and altitude at the study site are quite diverse. The altitude parameters also describe the habitat conditions of *Lepisanthes rubiginosa* which are very diverse. This can indicate that this species grows at a fairly diverse altitude and is spread on a broad altitude gradient at Mt. Baung NTP. As an illustration, some locations are located with shade trees and bamboo clumps that are quite dense, but in other locations are in an open area dominated by shrubs and bush vegetation. This condition causes differences in the value of light intensity at the study site. By using cluster analysis, the similarity in the conditions of environmental parameters at each location of the observation block is displayed in a graph of the average values of the observed growth environment parameters (Figure 7). The general conditions for the location of blocks for placement of observation plots are as follows:

1. Block 1, the location is on the slope, hilly, with vegetation dominated by “bambu duri” (*Bambusa blumeana*);
2. Block 2, the location is on the slope, hilly, with relatively dense tree vegetation and few bamboos;
3. Block 3, the location is on the slopes and ridges with relatively dense tree vegetation and few bamboos;
4. Block 4, the location is on the slopes, hilly, with the dominance of bamboo *Schizostachyum zollingeri*;
5. Block 5, the location is on the slopes, hilly, with bush predominance

From the results of cluster analysis, it can be seen that there are two major groups namely group 1 consisting of blocks 1, 2 and 3 and group 2 consisting of blocks 4 and 5. However, it can be said that the environmental parameters of each observation block are relatively the same because the similarity value is very high (range between 99-100).
Figure 7. Dendogram of the environmental conditions of the L. rubiginosa habitat at Mt. Baung

4. Conclusion
From this research it can be seen that there is a population of Lepisanthes rubiginosa that grows naturally in the conservation area of Mount Baung Nature Tourism Park. Lepisanthes rubiginosa at Mount Baung is more common in the seedling and sapling phases, with the number of details for each growth stratum as follows: sapling level of 80 individuals, sapling level of 81 individuals, sapling level of 1 individual, and tree level of 1 individual. Based on the average individual density graph at the study site, the population conditions are still in normal conditions for a plant species. The number of individual densities in the young stratum is more than the adult stratum. Lepisanthes rubiginosa habitus in adult strata in the form of shrubs and / or small trees. The possibility of a reduction in the population of Lepisanthes rubiginosa can occur due to utilization or cut down due to community ignorance. Therefore, efforts to introduce plants and their benefits and conservation efforts need to be done.

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Appendix 1. Importance Value Index of seedlings and undergrowths (the 15 largest values)

| No | Species                  | KR   | FR   | DR   | INP  |
|----|--------------------------|------|------|------|------|
| 1  | Tithonia diversifolia   | 21.510 | 2.242 | 21.509 | 45.261 |
| 2  | Mikania cordata          | 8.552  | 4.755 | 8.552  | 21.860 |
| 3  | Cyathula prostata        | 9.054  | 2.446 | 9.053  | 20.553 |
| 4  | Piper cubeba             | 5.985  | 3.533 | 5.985  | 15.503 |
| 5  | Pennisetum purpureum    | 6.623  | 0.476 | 6.623  | 13.722 |
| 6  | Voacanga grandifolia    | 2.810  | 5.163 | 2.810  | 10.783 |
| 7  | Parameria laevigata      | 3.205  | 2.853 | 3.205  | 9.264  |
| 8  | Pterocymbium javanicum   | 3.251  | 0.747 | 3.251  | 7.249  |
| 9  | Streblus asper           | 1.489  | 4.008 | 1.489  | 6.985  |
| 10 | Lepisanthes rubiginosum  | 1.170  | 3.533 | 1.170  | 5.872  |
Appendix 2. Importance Value Index of sapplings (the 15 largest values)

| No | Species                        | KR     | FR     | DR     | INP    |
|----|--------------------------------|--------|--------|--------|--------|
| 1  | *Tithonia diversifolia*        | 39.216 | 1.702  | 39.210 | 80.127 |
| 2  | *Streblus asper*               | 11.249 | 12.827 | 11.247 | 35.323 |
| 3  | *Voacanga grandifolia*         | 5.986  | 9.424  | 5.985  | 21.394 |
| 4  | *Lepisanthes rubiginosum*       | 4.128  | 7.853  | 4.127  | 16.109 |
| 5  | *Syzygium pycnanthum*          | 3.612  | 4.581  | 3.611  | 11.805 |
| 6  | *Capparis micrantha*           | 1.909  | 4.581  | 1.909  | 8.399  |
| 7  | *Microcos tomentosa*           | 2.322  | 3.403  | 2.322  | 8.047  |
| 8  | *Schoutenia ovata*             | 3.044  | 1.832  | 3.044  | 7.921  |
| 9  | *Alectryon serratus*           | 1.703  | 3.010  | 1.703  | 6.416  |
| 10 | *Syzygium racemosum*           | 1.806  | 2.749  | 1.806  | 6.360  |
| 11 | *Ficus hispida*                | 1.187  | 2.487  | 1.187  | 4.860  |
| 12 | *Canthium glabrum*             | 1.290  | 1.702  | 1.290  | 4.281  |
| 13 | *Protium javanicum*            | 0.774  | 1.963  | 0.774  | 3.511  |
| 14 | *Litsea glutinosa*             | 0.877  | 1.702  | 0.877  | 3.456  |
| 15 | *Tabernaemontana sphaerocarpa* | 0.826  | 1.702  | 0.825  | 3.353  |
### Appendix 3. Importance Value Index of poles (the 15 largest values)

| No | Species                      | KR  | FR  | DR  | INP  |
|----|------------------------------|-----|-----|-----|------|
| 1  | *Streblus asper*             | 20.465 | 17.221 | 19.513 | 57.199 |
| 2  | *Syzygium pycnanthum*        | 9.767 | 8.459 | 9.428 | 27.655 |
| 3  | *Voacanga grandifolia*       | 7.209 | 7.553 | 6.533 | 21.295 |
| 4  | *Microcos tomentosa*         | 6.047 | 6.647 | 5.910 | 18.603 |
| 5  | *Schoutenia ovata*           | 6.279 | 3.323 | 7.139 | 16.741 |
| 6  | *Syzygium racemosum*         | 3.256 | 3.927 | 3.199 | 10.382 |
| 7  | *Ficus hispida*              | 3.023 | 2.719 | 3.401 | 9.143  |
| 8  | *Litsea glutinosa*           | 2.093 | 2.417 | 2.105 | 6.614  |
| 9  | *Pittosporum moluccanum*     | 2.093 | 1.813 | 2.441 | 6.347  |
| 10 | *Protium javanicum*          | 1.860 | 2.417 | 1.919 | 6.197  |
| 11 | *Tabernaemontana sphaerocarpa* | 2.326 | 2.417 | 1.397 | 6.140  |
| 12 | *Wrightia tomentosa*         | 1.628 | 2.115 | 1.886 | 5.628  |
| 13 | *Syzygium litorale*          | 1.628 | 2.115 | 1.886 | 5.628  |
| 14 | *Canthium glabrum*           | 2.093 | 1.208 | 1.936 | 5.238  |
| 15 | *Emblica officinalis*        | 1.395 | 1.813 | 1.549 | 4.737  |

### Appendix 4. Importance Value Index of trees (the 15 largest values)

| No | Species                      | KR  | FR  | DR  | INP  |
|----|------------------------------|-----|-----|-----|------|
| 1  | *Ficus hispida*              | 8.373 | 8.108 | 5.793 | 22.274 |
| 2  | *Schoutenia ovata*           | 9.670 | 3.657 | 7.263 | 20.589 |
| 3  | *Syzygium pycnanthum*        | 7.547 | 3.975 | 5.752 | 17.274 |
| 4  | *Streblus asper*             | 5.307 | 5.882 | 3.789 | 14.978 |
| 5  | *Microcos tomentosa*         | 4.835 | 5.246 | 3.871 | 13.952 |
| 6  | *Garuga floribunda*          | 3.774 | 4.610 | 4.335 | 12.720 |
| 7  | *Ficus racemosa*             | 1.651 | 1.908 | 7.117 | 10.675 |
| 8  | *Emblica officinalis*        | 4.009 | 3.339 | 3.196 | 10.544 |
| 9  | *Litsea glutinosa*           | 3.774 | 3.657 | 2.734 | 10.165 |
| 10 | *Albizia lebbeckoides*       | 2.948 | 3.339 | 2.498 | 8.785  |
| 11 | *Artocarpus elasticus*       | 2.241 | 2.226 | 3.830 | 8.296  |
| 12 | *Dysoxylum gaudichaudianum*  | 2.241 | 2.226 | 1.998 | 6.465  |
| 13 | *Pittosporum moluccanum*     | 2.005 | 2.226 | 1.408 | 5.639  |
| 14 | *Alstonia scholaris*         | 1.415 | 1.908 | 2.124 | 5.447  |
| 15 | *Wrightia tomentosa*         | 1.887 | 1.908 | 1.581 | 5.375  |

### Appendix 5. Importance Value Index of bamboos

| No  | Species                      | KR  | FR  | DR  | INP   |
|-----|------------------------------|-----|-----|-----|-------|
| 1   | *Bambusa blumeana*           | 63.741 | 76.048 | 85.338 | 225.127 |
| 2   | *Schizostachyum zollingeri*  | 24.317 | 11.377 | 10.392 | 46.086 |
| 3   | *Schizostachyum iraten*      | 9.209 | 5.988 | 2.949 | 18.146 |
| 4   | *Dendrocalamus asper*        | 1.295 | 2.994 | 0.605 | 4.894  |
| 5   | *Bambusa vulgaris*           | 1.007 | 2.994 | 0.419 | 4.420  |
| 6   | *Giganthocloa apus*          | 0.432 | 0.599 | 0.282 | 1.312  |
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