

Research Article

Species Diversity and Potential Utilization of Moraceae in Nglanggeran Ancient Volcano, Gunungkidul Regency, Yogyakarta

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ABSTRACT

Nglanggeran Ancient Volcano is one of the ecotourism areas in Gunungkidul Regency, Yogyakarta. This ancient volcano is one of the geological sites in Pegunungan Sewu. Pegunungan Sewu is a National Geopark in Indonesia and has been designated as a UNESCO Global Geopark since 2015. The determination of an area into a National Geopark and Global Geopark makes the biodiversity in the area must be protected and preserved, including the plant diversity, one of which is Moraceae. The ecological and economic importance of Moraceae in Nglanggeran Ancient Volcano has not been documented properly. This fact encourages the need to do this research. The aim of this research was to record species diversity of Moraceae and its potential uses. The research was conducted in August-November 2019 at Nglanggeran Ancient Volcano and followed by data analysis in Plant Systematic Laboratory, Faculty of Biology, Universitas Gadjah Mada. The samples were collected at two different tracks, covering the track to the peak and the pathway down. There were six species found, namely *Artocarpus altilis* (Parkinson) Fosberg, *Artocarpus heterophyllus* Lam., *Ficus benjamina* L., *Ficus septica* Burm. f., *Maclura cochinchinensis* (Lour.) Corner, and *Streblus taxoides* (Roth) Kurz. The potential uses of Moraceae by local people were identified from the interview and enriched by data from literature studies indicated that Moraceae plants were used as a food, medicine, for construction, soil protection plants, and houseplant.

Keywords: Moraceae, Nglanggeran Ancient Volcano, Plant potential uses, Species diversity

INTRODUCTION

Nglanggeran is an ancient volcano and a popular historic geological site in Pegunungan Sewu renowned as one of the ecotourism areas in Gunungkidul Regency, Yogyakarta. Pegunungan Sewu is a National Geopark in Indonesia and has been designated as a UNESCO Global Geopark since 2015 (Ministry of Energy and Mineral Resources, 2018). The concept of Geopark which was initiated by UNESCO applies a sustainable regional development concept that integrates three aspects of diversity, namely geodiversity, biodiversity, and cultural diversity. This concept aims at developing the economy of local communities based on the protection of the three diversities (UNESCO, 2014; Ministry of Energy and

Mineral Resources, 2018). In this study, biological diversity is the main focus as presented as the inventory of species diversity. The cultural diversity aspect was observed by documenting the utilization of Moraceae species by local people. Meanwhile, the geological diversity aspect is not examined in this study because it is not under the scope and competence of the authors.

The determination of an area into a National Geopark and Global Geopark makes the biodiversity in the area must be protected and preserved, including the plant diversity, one of which is Moraceae. Moraceae is a family of Angiosperm consisted of 37 genera and approximately 1.100 species, with *Ficus* being the largest genus within the family with 600 species (Singh, 2010). Moraceae are distributed in tropics, subtropics, and temperate regions (Clement & Weiblen, 2009; Singh, 2010). *Ficus* has a critical ecological function in tropical rainforest ecosystem, also as an important food

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source for a wide range of frugivores (Datwyler & Weiblen, 2004; Harrison, 2005). The family is important for its fruits such as mulberry (*Morus alba* L., *Morus nigra* L.), fig (*Ficus carica* L.), and breadfruit (*Artocarpus altilis* (Parkinson) Fosberg). Leaves of *Morus* are widely known for rearing silkworms (Singh, 2010). The ecological and economic importance aspects of Moraceae in Nglanggeran Ancient Volcano have not been documented properly. This fact encourages the need to do this research. The aim of this research was to record species diversity of Moraceae and their potential uses, which covers the biological and cultural diversity aspects of geopark concept, whereas geological diversity was not included in this study due to the reasonable consideration of being out of the author's competence.

MATERIALS AND METHODS

Materials

The materials used in this study were plant samples collected from two different tracks of Nglanggeran, alcohol 70%, specimen label, plastic bags, herbarium envelope, herbarium sheet, and newspaper. The tools used in this study were garden scissors, cutter, oven, sprayer, digital camera NIKON J5, smartphone, GPS (Global Positioning System), altimeter, rope, board, cardboard, and identification books. Data on the potential use of Moraceae

species was gathered using questionnaires collected from local people by the assistance of POKDARWIS (working group for tourism).

Methods

Plants specimens were taken from its natural population along two different tracks, covering the track to the peak and the pathway down (Figure 1). The specimens were documented by taking the photograph of the whole plant and its habitat before being preserved into dried herbarium specimens. Identifications were carried out based on the morphological character using an online database (Digital Flora of Eastern Ghats, Kew Herbarium Catalogue, Useful Tropical Plants Database) and identification books (Flora of Java, Flora Malesiana). Data on potential use and current utilization of Moraceae plants was obtained by gathering the information from the local community using a simple questionnaire and enriched with information from relevant literature. There were four questions in the questionnaire asked the local people, namely: (1) whether local people are allowed take plants in the tourist area or not; (2) what species commonly used by local people; (3) what plant parts that are usually used by local people; and (4) what is the common utilization of the plants by local people. The results obtained were presented as species descriptions and information on their potential uses.

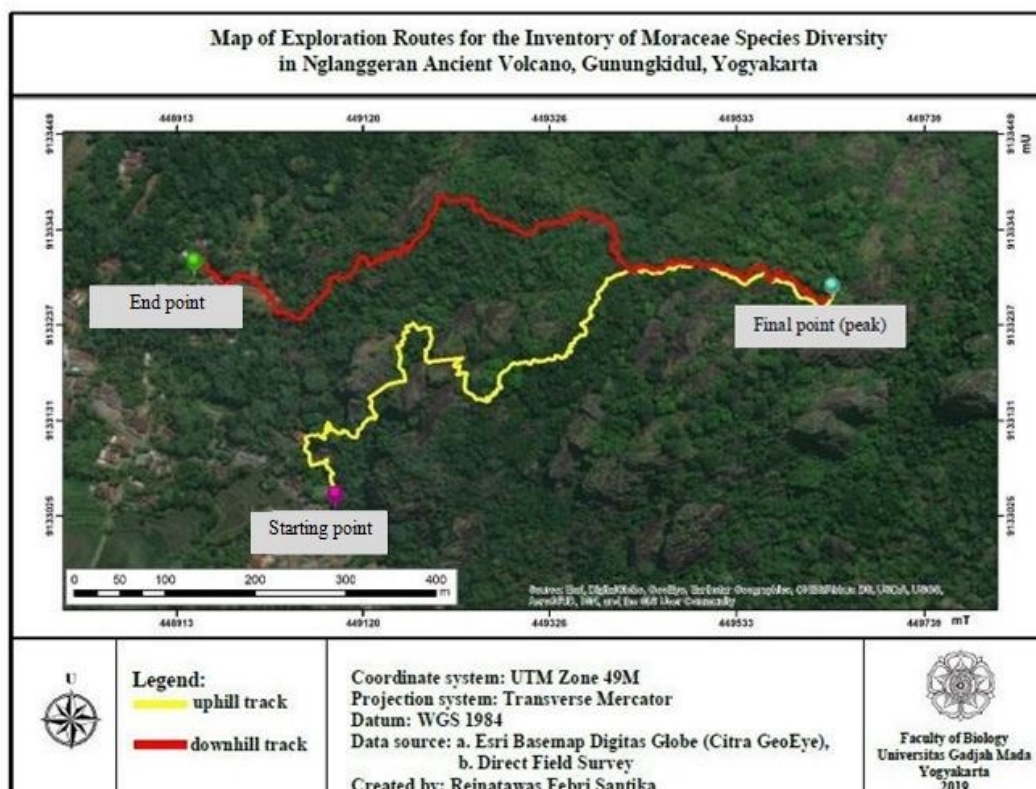


Figure 1. Tracks of specimen collection in Nglanggeran Ancient Volcano



Figure 2. Species of Moraceae found in Nglanggeran were *A. altilis* (1), *S. taxoides* (2), *F. septica* habit (3), *F. septica* inflorescences (4), *F. benjamina* (5), *M. cochinchinensis* habit (6), *M. cochinchinensis* inflorescences (7), *A. heterophyllus* (8).

RESULTS AND DISCUSSION

Six species consisted of four genera of Moraceae were found during field exploration in Nglanggeran Ancient Volcano area (Figure 2). These species were *Artocarpus altilis* (Parkinson) Fosberg, *Artocarpus heterophyllus* Lam., *Ficus benjamina* L., *Ficus septica* Burm. f., *Maclura cochinchinensis* (Lour.) Corner, and *Streblus taxoides* (Roth) Kurz.

A previous study by Widodo and Luthfi (2017) found 10 species of Moraceae in Nglanggeran Ancient Volcano, namely *Fatoua* sp., *Morus* sp., *Malaisia scandens* (Lour.) Planch., *Streblus asper*, *S. taxoides*, *M. cochinchinensis*, *F. benjamina*, *F. septica*, *F. montana* Burm. f., and *Artocarpus integra* (Thunb.) Merr. Results of this exploration showed that there were only six species found (Figure 2), namely *A. altilis*, *A. heterophyllus*, *F. benjamina*, *F. septica*, *M. cochinchinensis*, and *S. taxoides*.

The difference in the number of species found can be due to differences in exploration scope areas or exploration tracks, the presence of plants in areas that were too dangerous to explore (such as steep slope), and the difference of season when explorations were carried out. The six species found

during the course of study was ranging from the lowest with only two individuals for *S. asper*, three for *A. altilis*, four for *A. heterophyllus*, five for *F. septica*, and eleven individuals for both *F. benjamina* and *M. cochinchinensis*.

The results of this study showed that species diversity of Moraceae in Nglanggeran ancient volcano was low, as indicated by only six species was found. This number is notably lower compared to similar studies by Widodo and Lutfi (2017) who obtained 10 species of Moraceae in Nglanggeran. When compared to other locations, the number of *Ficus* species obtained in this study was only two, much lower than similar studies conducted in Prof. Soemitro Djojohadikusomo Conservation Forest West Sumatra which found 20 *Ficus* species (Nur'aini *et al.*, 2013). A study by Rahadianoro and Siahaan (2016) on the diversity of Moraceae tree species in Telogo Dowo, Sempu Island recorded 14 species. The number of *Ficus* species found in this study was also very small compared to that obtained by Almulqu *et al.* (2018) in Mutis Timau Protected Forest, East Nusa Tenggara. Based on these comparisons, the diversity of Moraceae species in

Nglangeran ancient volcano revealed in this study was obviously low.

The six species found in this study were collected from their habitat at the elevation 200-700 mdpl. *Artocarpus altilis* and *Artocarpus heterophyllus* were found at 200 mdpl, and these two species were also known planted by local people in their yard. *Ficus benjamina* was mostly found near the rocky karst areas at 200-670 mdpl. *Ficus septica* also found in similar habitat at 200-460 mdpl. *Maclura cochinchinensis* was found at 200-638 mdpl, while *Streblus taxoides* was found at 460 mdpl. The Morphological description of these six species was presented below.

Artocarpus altilis

An evergreen tree that is monoecious with heights up to 15-20 m, smooth bark, may reach a height of 4 m before branching, two large stipules enclosing the terminal bud, up to 30 cm, yellowing and falling when leaves fold or inflorescences emerge. Leaves obovate to broadly ovate, spirally arranged, thick leaves, leathery, margin entire, acuminate apex, top dark green, often glossy, pale green and dull underside with an elevated midrib and main veins. Mature leaves pinnatipartite with 3-8 segments, while juvenile leaves on young trees and new shoots of mature trees usually larger, more dissected, and more hirsute. Leaves sometimes smooth but often with few reddish hairs on midrib and veins. Male inflorescences have yellow, cylindrical, 7-30 cm lengths, composed of hundreds of flowers attached to the spongy core. Male flowers have a tubular calyx, apically 2-lobed, and elliptic anthers. Female flowers have a tubular calyx, ovary ovoid, long styled, and apically 2-branched. The fruit has a highly specialized structure, a syncarp, composed of 1500-2000 flowers attached to the fruit axis or core. Fruit globose to oblong, light green rind, yellowish-green or yellow when mature, flesh creamy white or pale yellow, seedless, but some forms seeded, seeds have a thin dark-brown outer skin (thick \pm 0,5 mm) (Zhekun & Gilbert, 2003; Orwa *et al.*, 2009a).

Artocarpus heterophyllus

An evergreen tree with heights up to 8-25 m, straight stemmed, branching near the base, canopy dense, and dome-shaped. Bark is greyish-brown, rough, and sometimes scaly, all living parts of the tree exude white latex when injured. Leaves are elliptic to obovate, glossy, dark green top, pale green or light green underside, entire margin, blunt apex, cuneate or pointed base, alternately arranged on horizontal branches, spirally arranged on ascending branches. An individual flower is attached on an elongated axis and forming a raceme inflorescence. Male inflorescences have oblong, cylindrical, or clavate

with 2-7 cm length, peduncle 1-5 cm, yellowish, sterile flower has solid perianthium, fertile flower is tubular, and bi-lobed. Female inflorescence have oblong or cylindrical, rough, light to dark green skin, 5-15 cm length. Fruiting syncarp, pale yellow when young, yellowish-brown when mature, ellipsoid, globose, or irregularly shaped, covered by a rubbery rind and hard pyramidal, pointed or blunt spines. Syncarp composed of many fertilized ovaries developed into a yellow fruitlet. Unfertilized female flower developed into a hard strap or string-like structure, has white color, filling the space between fruitlets, called perigones. Seeds are oval-oblong or oblong-ellipsoid (Zhekun & Gilbert, 2003; Haq, 2006; Orwa *et al.*, 2009b).

Ficus benjamina

A monoecious, tree or strangler, hemi-epiphytic, with height up to 35 m high, producing aerial roots, and have brown to greyish bark. Leaves spirally arranged with lamina elliptic, oblong, to ovate, acuminate apex, rounded to obtuse base, entire margin. Inflorescence hypanthodium, there are male, female, and gall flowers within the same inflorescence. Male flower has short pedicellate and long filament. Female flower is sessile with 3 calyx lobes, short style, and enlarged stigma. Gall flower has 3-5 calyx lobes, ovoid ovary, and short style. Infructescences is syconium, yellow to orange or dark red when mature (Zhekun & Gilbert, 2003; Berg *et al.*, 2006).

Ficus septica

A dioecious Tree or shrub with yellowish latex and pale brown to yellowish-brown bark. Branchlets are thick and cylindric. Red stipules, ovate to lanceolate, with 2-3 cm length, and membranous. Leaves are alternate, lamina oblong, ovate-elliptic, or obovate, acuminate, mucronate, or sometimes caudate apex with base cuneate, and entire margin. Inflorescence hypanthodium, there are male, female, and gall flowers within the same inflorescence. Male flower near apical pore has 2 or 3 calyx lobes, 1 stamen, short filament, and ellipsoid anther. Female flower has long pedicellate, 2 or 3 calyx lobes, long style, and clavate stigma. Gall flower has short and transparent calyx lobes, ovoid to globose ovary, and short style. Infructescences syconium, green to light brown, has white small spots in rind, apical pore open when mature (Zhekun & Gilbert, 2003; Berg *et al.*, 2006).

Maclura cochinchinensis

An evergreen shrub that has long branches, dioecious, erect, or scandent. Branches are brown greyish, with 4 cm long straight or curved thorns.

Lamina is elliptic-lanceolate to oblong, apex shortly acuminate to subacute, base obtuse, rounded, or cuneate, and entire margin, spirally arranged. Female and male inflorescences are capitulum with a diameter of 0,4-1 cm. Male flower has 4 calyx lobes, and short anthers. Female flower did not have calyx lobes, basally connate. Fruiting syncarp with a diameter of 2-5 cm, orange-reddish when mature (Zhekun & Gilbert, 2003; Berg *et al.*, 2006)

Streblus taxoides

An evergreen shrub with heights up to 5 m, dioecious, much-branched, with thorns up to 1,5 cm long. Lamina is elliptic to oblong-lanceolate, acuminate to blunt apex, base is acuminate to obtuse, and entire margin. Male inflorescences spike or raceme, sessile. Male flower has short pedicellate, 4 calyx lobes, and globose anthers. Female flower is solitary, sometimes clustered, 4 calyx lobes, and apically style branched. Drupes globose, at first enclosed by enlarged calyx lobes (Zhekun & Gilbert, 2003; Berg *et al.*, 2006).

The fruit of *Artocarpus altilis* (breadfruit) is used as food and source of carbohydrates. Young and ripe fruit of *Artocarpus heterophyllus* (jackfruit) is also used as food and its seeds are sometimes boiled or roasted for food. Leaves of breadfruit and jackfruit are used as animal feed. Their trunk is used for construction material (Berg *et al.*, 2006).

Extracts and metabolites of breadfruit leaves, stems and fruit contain various useful active compounds such as antibacterial, anti-inflammatory, anti-diabetic, antifungal, and antioxidant activity (Sikarwar *et al.*, 2014). Jackfruit root extract is used to treat skin diseases, asthma, and diarrhea. Its leaf extract contains flavonoids, anthocyanin, tannins, and proanthocyanidin which can increase glucose tolerance in diabetic patients (Haq, 2006). *Ficus benjamina* has potential uses as a medicinal plant, including its fruit extracts and latex which were used to treat skin diseases, inflammation, malaria, as antimicrobial, antinociceptive, antipyretic, hypotensive, and anti-dysentery (Imran *et al.*, 2014). *Ficus septica* is used as traditional medicine for fever, headache, and stomach-ache (Ueda *et al.*, 2009). *Ficus septica* also has been reported as having cytotoxic activity against HONE-1 nasopharyngeal cancer cells and gastric cancer cells NUGC (Damu *et al.*, 2005). *Maclura cochinchinensis* wood can be used to treat for fever (Atika & Salma, 2017). *Streblus taxoides* root is used to treat glandular swellings, and its trunk is used to treat elephantiasis (Kadavul & Divit, 2008).

Jackfruit has a function as a shade tree and can reduce the impact of rainfall on the soil. They are sometimes also planted on slopes and hills to help

control soil erosion. The widespread root system can help the absorption of groundwater, and therefore reduce flooding (Haq, 2006). Intensive growth of *Ficus benjamina* roots can damage roads and sidewalks so it is less suitable as a shade plant on the roadside (Gilman & Watson, 2011). *Ficus benjamina* is widely cultivated as an ornamental plant. In Indonesia, *Streblus taxoides* are used for bonsai, but their use is already rare (Sulistyo, 2008). *Maclura cochinchinensis* woods are used as batik dye along with bark of *Ceriops tagal* and *Peltophorum pterocarpum* to make soga colors (Atika & Salma, 2017).

CONCLUSION

Species diversity of Moraceae in Gunung Api Purba Nglangeran is low based on comparison to other studies, either those from the same area or other regions in Indonesia. Six species were found in this study namely *Artocarpus altilis*, *Artocarpus heterophyllus*, *Ficus benjamina*, *Ficus septica*, *Maclura cochinchinensis*, and *Streblus taxoides*. The potential uses of Moraceae are food, medicine, for construction, soil protection plants, and houseplant.

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