A REVIEW ON TAXONOMY, BIOLOGY, ECOLOGY, AND POPULATION STATUS OF DALBERGIA LATIFOLIA FROM INDONESIA

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LIPI

A review on Taxonomy, Biology, Ecology, and Population Status of *Dalbergia latifolia* from Indonesia

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Introduction

Dalbergia latifolia Roxb. (Fabaceae) is known as sonokeling in Indonesia. The species may not native to Indonesia but have been naturalised in several islands of Indonesia since it was introduced from India (Sunarno 1996; Maridi et al. 2014; Arisoesilaningsih and Soejono 2015; Adema et al. 2016;). The species has beautiful dark purple heartwood (Figure 1). The wood is extracted to be manufactured mainly for musical instrument (Karlinasari et al. 2010). At present, the species have been cultivated mainly in agroforestry (Hani and Suryanto 2014; Mulyana et al., 2017). The main distribution of species in Indonesia including Java and West Nusa Tenggara (Djajanti 2006; Maridi et al. 2014; Arisoesilaningsih and Soejono 2015; Yulita et al. 2020).

Figure 1. Cross sectional trunk of *D. latifolia* from a population from Java (after Yulita and Susila 2019 unpublished).

Dalbergia latifolia was included in the Appendix 2 of CITES in 2016 (CITES 2017) and since then *D. latifolia* wood from Indonesia has received greater attention to the international market. In some parts of their current populations, the species is hardly found to set fruit and is hypothesised undergo an inbreeding depression due to intensive domestication vegetatively. Such conditions would not be valuable

for sustainable supply due to the increasing demand from the market. The CTSP Indonesia has commenced a project titled A Non-Detriment Findings (NDFs) Findings Report and A DNA database for *D. latifolia* in Java and West Nusa Tenggara, Indonesia. The project implementation was initiated to review the the taxonomy, biology, and ecology, population trend, structure and dynamics of *D. latifolia* occur in Indonesia based on literature study.

Taxonomy

Dalbergia latifolia Roxb. is a member of Fabaceae (Legume family). *Dalbergia* is a genus of the tribe Dalbergieae Bronn ex DC. of the Leguminosae subfamily Papilionoideae. The species has several common names including Bombay Blackwood, Indian Rosewood, Indonesian Rosewood, Malabar Rosewood, Indian palisandre, Java palisandre, Roseta rosewood. The species was firstly described by Roxburgh in 1779. The synonyms of this species include *Amerimnon latifolium* (Roxb.) Kuntze, *D. emarginata* Roxb., *D. emarginata* Roxb., and *D. javanica* Miq. Sunarno (1996) reported that *D. latifolia* is a non-native species to Indonesia, the species is most likely introduced to Indonesia during the dutch-colonial time from the southern Asia.

Several forms/morphotypes of *D. latifolia* and look-alike species are recorded, and this often raised a complication about the identity of the species because they are look-alike. In Java, *D. latifolia* may existed as two morphotypes, i.e. sonokeling, and sonobrit. However the taxonomic assignment of these two morphotypes is remained unclear. The main difference between the two forms is that the sonokeling tend to have straight bole, while the sonobrit have crooked bole. The wood of sonobrit is less valuable than the sonokeling due to its crooked form and because it produces a more dull colored heartwood (Winfield et al. 2016). The traded *D. latifolia* in Indonesia mostly refers to sonokeling.

Morphological description

Dalbergia latifolia is a medium-sized to large tree which can reach up to 40 m tall; bole straight or slightly twisted, branchless for up to 12(–24) m, up to 180 cm in diameter, often with prominent buttresses, bark surface whitish to grey, thin,

becoming flaking; crown rounded to dome-shaped" (Soerianegara and Lemmens 1993; Lemmens 2008). Leaves arranged spirally, imparipinnately compound with (3–)5–7(–9) leaflets (Figure 2); stipules small, caducous; petiole and rachis glabrous; petiolules up to 1 cm long; leaflets alternate, broadly obovate to elliptical-oblong, 4–12 cm × 2.5–9 cm, obtuse, rounded or notched at apex (Figure 2), papery or thinly leathery, glabrous" (Soerianegara and Lemmens 1993; Lemmens 2008). Inflorescence located at terminal or axillary, the panicle 5–15 cm long, laxly branched, almost glabrous, many-flowered" (Soerianegara and Lemmens 1993; Lemmens 2008).

Figure 2. Watercolour illustration of *D. latifolia* (http://www.plantsoftheworldonline.org/taxon/urn:lsid:ipni.org:names:490294-1)

Flowers bisexual, papilionaceous, 6–8 mm long (Figure 2), distinctly pedicellate; calyx campanulate, c. 4 mm long, lobes shorter than tube, lower lobe longest, upper lobes fused; corolla whitish, with obovate standard and clawed wings and keel; stamens usually 9, fused into a tube, but free in upper part; ovary

superior, with distinct stipe at base, style short". Fruit a flat, elliptical to oblong, papery pod 4–10 cm × 1.5–2.5 cm, with stipe up to 1 cm long, glabrous, reticulately veined, indehiscent, 1–3(–4) seeded. Seeds kidney-shaped, 7–10 mm long" (Soerianegara and Lemmens 1993; Lemmens 2008).

Biology

Both the sonokeling and sonobrit are considered as the native 'varieties' to Java. The sonokeling is slow growing, have a straight bole, seldom to produce seeds and mainly reproduced by suckers (Jøker 2004). The sonobrit is also considered as a naturalized variety that produce seeds on a yearly basis (Jøker 2004). The sonobrits is considered fast growing and is often used in land rehabilitation programme.

The species reproduced mainly through root suckers. The mature trees are often surrounded by numerous root suckers. Personal field observation suggested that the root suckers may reach 10 meters or more in distance. A more detail study on root sucker system is *D. latifolia* may required to carry out. Currently, the main threat of sonokeling is the attack of a species of fungi that has vernacular name as Upas. This fungi attacks the bark of the stem that cause death to the trees. If such attack happened in a homogeneous or uniform population, all the individuals in the population are also threatened (Yulita and Susila 2019 unpublished). More detail study on pest attack and diseases on *D. latifolia* is therefore important to prevent certain populations from extinction.

There is no detail record on phenology of this species, but it is suspected that the flowering and fruiting season is different among regions. The flowering season of sonokeling in Central Java is started around November in 2018 and 2019 (personal observation), while in Lombok island the flowering season may vary every year (pers. comm.). The sonokeling trees in Java has an average annual height growth of 2 m and an annual volume increment of 15 m^3/ha in favourable sites.

Distribution and range

Dalbergia latifolia is native to tropical Asia, distributed from Nepal to India and Indonesia (Figure 3). They have been planted in tropical Asia, and locally also in tropical Africa, e.g. in Nigeria, Kenya, Uganda and Tanzania, and also in Réunion and

Mauritius (Lemmens 2008). In Indonesia, *D. latifolia* largely distributed in Java especially in Central Java, East Java, and D.I. Yogyakarta and in West Nusa Tenggara (e.g. Lombok island). Two studies have reported the occurence of *D. latifolia* in several populations in Java and Lombok island (Atikah and Dede 2018 unpublished; Yulita and Susila 2019 unpublished). In D.I. Yogyakarta, the tree stands can be found in Kulon Progo District (Sermo Wildlife Reserve) at the altitude of 70-100 m asl. This species dominated the area which used to be a concession forest and currently this area formed natural forest. In Gunung Kidul District (D.I. Yogyakarta), *D. latifolia* population found in Semoyo Village at the altitude 250 m asl. This species was found in a mix agroforestry area. Whereas in Lombok Island, *D. latifolia* from West Lombok District grow at the elevation 19-224 m asl. and East Lombok Districts at 66 m asl. The populations grow in the cultivated stand, under mix agroforestry and monoculture system, which is a part of restoration programme. Furthermore, Dwianto et al. (2019) also reported that *D. latifolia* stands grow in Pagerwuning Darupodo Nature Preserve Area (33.20 ha), Wildlife Reserve Area of Mount Tunggangan (102.475 ha), Natural Tourist Park of Mount Selok (116.166 ha) of Central Java. Other reports (unpublished) have suggested that the species may have wider distributions covering Sumatra, Sulawesi and Timor Island.

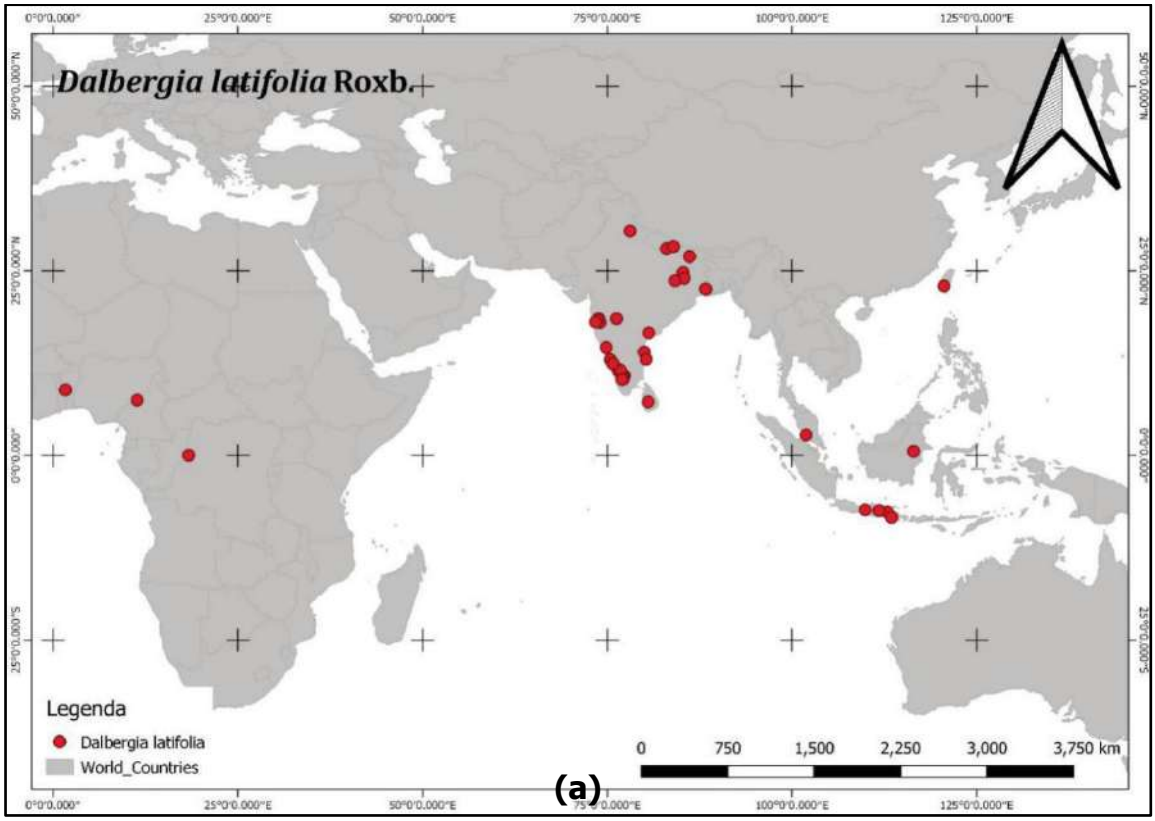

Figure 3. Distribution map of *Dalbergia latifolia* worldwide. The data derived from GBIF (www.gbif.org) with some corrections of points based on published articles and herbarium specimens. Shapefile (.shp) of worldwide basemap downloaded from http://tapiquen-sig.jimdo.com. Carlos Efraín Porto Tapiquén. Orogénesis Soluciones Geográficas. Porlamar, Venezuela, 2015.

Ecology

In many areas of tropical Asia, *D. latifolia* occurs scattered in deciduous forest with periodically very dry season in the altitude of up to 900(–1500) m with the annual rainfall ranges between 750 and 5000 mm. However, *D. latifolia* thrives in areas with up to 6 dry months with mean monthly rainfall of less than 40 mm. They can survive in locations with maximum temperatures of 37°C-50°C, minimum temperature of 15° – 0°C, and relative humidity of 40-100%. As a seedling, *D. latifolia* is a shade tolerant species but sensitive to drought and fire. The mature trees are tolerant to drought and ground fire, but susceptible to crown fire and are considered as a moderate light demander. When the trees grow in open sites, they tend to become crooked and branchy. They grow well on deep, permanently moist but well-drained soils, but also attains large dimensions on vertisols. The also grow well on black cotton soilson a variety of soil formations including; geneiss, trap, laterite, alluvial, and boulder deposits. Shallow dry soils and poor drainage stunt tree growth. In

agroforestry areas, they are commonly found to grow together with *Tectona grandis*, *Terminalia* sp., *Anogeissus latifolia,* and bamboos (Troup 1921; Soerianegara and Lemmens 1993; Prasad and Sukandi 1994; Lemmens 2008).

Population status: size, structure and dynamics

The species is categorized this species as Vulnerable (VU A1cd) based on the IUCN redlist (1998). However, there is no available data on the present population size, structure, and dynamic recorded from Indonesia yet. In fact such information is very valuable in contributing designation of non-detrimental finding. Only a few information found in Yulita et al. (2020) who conducted the preliminary research in D.I. Yogyakarta and Lombok Island on genetic variations with the addition to the general information of the population structure (dbh range and a brief regeneration condition). In D.I. Yogyakarta, there were two study sites, in Kulon Progo District and Gunung Kidul District. In Kulon Progo, the mature trees have an average dbh of 30 cm with saplings and seedlings scattered surrounding the parent trees. Several mature trees are more than 50 cm indbh and reached the diameter 80 cm. In Gunung Kidul, the mature trees are rarely found in diameter more than 50 cm. On average, the diameters for the mature trees are 20-30 cm. In Lombok Island, the study was conducted in two locations, West Lombok and East Lombok District. In West Lombok District, the were two study sites, the first study site has an average diameter of mature trees 18.08 cm and the largest diameter found was 40.76 cm. The second study site in West Lombok District has an average diameter of mature trees 21.43 cm, and several trees reached 40 cm in diameter. The seedling and sapling were very abundant in those two sites. In the East Lombok District, the average diameter of mature tree was 32.07 cm and the largest tree diameter was 44.11 cm. There is no information regarding this species regener.

The history of trade and management of *D. latifolia* in Indonesia

Dalbergia latifolia is often used for high-class furniture raw materials such as bookshelves, cabinets, and even often also used for decorative wood in cruise's ship and instruments cases. In the market, this wood is suitable for high grade plywood considering its beautiful color and figure for decorative veneers. It has high strength

and long lasting period of uses so that people fond of use them as constructional materials. This wood is also used as a carving material. Indonesia exports a lot of raw materials for musical instruments and sports equipment. *Dalbergia latifolia* can be used as shade tree, especially in agroforestry systems. In the past, government use them for aforestation in a prone erosion soil and also as soil improver fixing nitrogen including its benefits for mulch. Foliage can be used as fodders. However, finding *Dalbergia* trees with suitable diameter for various purposes is no longer easy as not so many big trees left outside in the wild. Therefore, this species is one of the most valuable timbers and currently the price is higher that teak which is also known as fancy and high valuable wood in Indonesia. Its plywood product is exported. *D. latifolia* has quite a large potential for country's foreign exchange, thus their trade requires guidance from Ministry of Forestry and Environment. The biggest source of timber trading for this species to date has been obtained from Perhutani plantation and not from the wild. However, illegal logging for *D. latifolia* is still occurring quite recently inside the protected forest areas in Lampung Province. Based on CITES notifications in November 7th 2016 and November 14th 2016 regarding Amendment to Appendices I and II Convention which were adopted at COP 17 CITES on 24 September to 4 October 2016 in Johanesburg, South Africa, it was mentioned that *D. latifolia* was included in the CITES Appendix II list (CITES 2017). The market and trade of *D. latifolia* must be managed properly to prevent banning of Indonesian *D. latifolia* by other importing countries.

Conclusion and further work

As one of the most valuable timbers and have been utilised extensively for long period of time, the fundamental aspects related the the biology of *D. latifolia* in Indonesia is not yet understood. When we discovered the occurence of two morpho-types during our literature study, this will need careful and extensive sampling in Java and even in the other islands so that the morphological variations can be determined, and hence delimitation of the variations can be done accurately. The clarification of the variations of these two forms is essential to resolve because it will result in serious implication to the trading of *D. latifolia* and its look-alike species (variant) from Indonesia. Another aspect we found critical is the reproductive system

such as flowering behaviour, and population dynamics. In order to utilised sustainably, it is imporant to ensure that the number of populations and viable population size are well recorded. In addition, the coverage of present distributions including local agroforestry is also need to be verified. The chain of custody for legal trade has already been well recorded by the authority bodies. However, it is undoubtedly that illegal logging and trading is still exist to certain extent, and this also required detail ground surveys to ensure the formal regulation on trading the *D. latifolia* domestically and internationally has inline with national and international regulations. Hence, fundamental information covered in this article will be the main focus of the project implementation so as toto formulate more accurate NDF determination so as to ensure a good management practices based on scientific information.

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